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Basic Knowledge of Factors that Limit the Practice of low-impact Behaviors

Draft Report

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Chapter
1

INTRODUCTION

INTRODUCTION

Natural resource managers are faced with a continuing need to effectively communicate with, and persuade, the visiting public. Efforts to inform and induce compliance with various regulations have been attempted in order to prevent further degradation of the social and environmental conditions of the recreation site. However, most educational efforts have focused on the dispersal of information and yet it is unclear whether it is a lack of information that is limiting behavioral compliance. Indeed, it is suggested that factors such as a lack of awareness of a problem, social normative pressure, presence or absence of an underlying ethic, habit, and an inability to carry out the appropriate behavior may be equally limiting. For the natural resource managers to be more effective communicating with recreationists concerning their role in managing the impacts of their visit, a clearer understanding of the factors that are influencing compliance is needed.

Low-impact practices in a backcountry context.

Much wilderness and backcountry management is a balancing of environmental and social concerns. A primary objective of these areas is the preservation of natural settings and the minimization of evidence of human activity. Clearly this requires attention to both ecological and behavioral concerns. Furthermore, recreation itself involves a delicate balance between socially and environmentally acceptable behavior and the perceived freedom of the experience (Neulinger, 1974). As Hendee et al. (1990) suggest, the efforts of backcountry and wilderness managers should emphasize indirect methods that are designed to minimize impact on the natural resource and to minimize the affect on the recreationists' experiences. Because backcountry recreationists require such high levels of personal freedom, their decisions throughout their recreation experiences are of critical importance. In this report, we are

interested in documenting how cognitive processes, environmental perceptions, and social influences determine how people make decisions and behave in the backcountry.

Resource impacts resulting from backcountry recreation have been an impetus of much of this research, and recreation managers have access to numerous studies that have identified how different recreation behaviors contribute to the overall impact an area receives (Cole, Peterson and Lucas, 1987). However, there has been less corresponding research devoted to understanding the behavioral decisions people make that lead to these impacts. This study seeks to gain an understanding of those decisions and how managers can influence visitor behavior and help minimize unnecessary resource impacts. Through a better understanding of the motives and reasons that ultimately affect how people behave, recreation managers will be better able to structure recreation opportunities that minimize resource impacts while at the same time preserving the integrity of the experience. Specifically, we seek to investigate the reasons why some knowledgeable people disregard certain low-impact recommendations, such as Leave No Trace, while camping in the backcountry.

The Leave No Trace campaign evolved from a US Forest Service initiative to create a standardized, cohesive set of directions for wilderness users. Currently, Leave No Trace (LNT) consists of recommendations that recreationists should follow when they find themselves in backcountry situations. LNT is specifically designed to minimize the biological and social impact of visiting the backcountry, and to instill an outdoor ethic of care and respect. Despite the efforts of the federal land management agencies and the National Outdoor Leadership School (NOLS), low-impact recommendations are not consistently practiced even by those people who profess an understanding of the concepts. Since the inception of public information campaigns such as LNT, the assumption has been that providing the recreationist with accessible information about appropriate behavior is all that is needed to achieve desired results. However, it has been found that although recreationists can correctly answer questions about low-impact behaviors, they may not be actually carrying out those behaviors (Stubbs, 1991). This suggests that visitors may be receiving the message of low-impact recommendations, but not consistently following these recommendations. Furthermore, recreationists have been found unable to remember the point of specific low-impact messages when they are exposed to more than two recommendations (Cole, Hammond and McCool, 1997). In this case, cognitive overload appears to be limiting recall of specific recommendations. Therefore, it would seem that while some degree of knowledge about low-impact recommendations is necessary for compliance, a lack of information about acceptable behavior may not be the only limiting factor in noncompliance.

Some of the hypothesized explanations for this noncompliance include: cognitive failure in the form of faulty decision-making; ineffective attitude shift when confronted by new information; habituated negative behaviors; an inability to carry out appropriate behaviors; and possibly normative influences and social pressures. The purpose of this study is to develop a thorough understanding of the effect of these potential explanations in the process of backcountry behavior.

Generating further understanding of the many factors that influence backcountry decisions and behavior should be viewed as a primary goal of advancing the objectives of the LNT campaign. As, Roggenbuck (1992) noted we understand little of the ultimate effectiveness of low-impact campaigns such as LNT. Perhaps our uncertainty of this effectiveness stems from a lack of knowledge about the actual behaviors with which we are concerned. A more thorough understanding of the behavior will lead us towards a better way to evaluate the effectiveness of certain information campaigns. This report will often use the selection of backcountry campsites as the specific low-impact recreation behavior partly as a result of the extensive and clear LNT recommendations on campsite selection (Hampton and Cole, 1995).

Several studies have examined the phenomenon of campsite choice. Brunson and Shelby (1990) synthesized six of these studies and they grouped campsite attributes into three broad categories: necessity attributes, experience attributes, and amenity attributes. And while these researchers found correlations between campsite choice and campsite attributes, Manning (1986) suggests that these types of campsite preferences may not be the best way to examine the issue of campsite selection. The consistent theme with each of those three attribute types is based on the functionality of the campsite to the camper, as opposed to selecting a campsite based on its ecological appropriateness. In other words, these previous campsite selection studies have approached the issue from campsite utility where attributes such as flatness, shade, screening, naturalness were the associative decision factors. Whether or not a campsite was a good campsite based on low-impact recommendations, has received little attention. While the role of functional campsite attributes may be of some importance, particularly as it relates to the campsite choice model developed by Brunson and Shelby (1990), no study to date has approached campsite selection from the perspective of being compatible with low-impact recommendations. This is after all of paramount importance in backcountry and wilderness settings.

Furthermore, research to evaluate the effectiveness of low-impact communication strategies as they relate to recall of messages (Cole et al., 1997) measured whether or not

recreationists were aware of appropriate behavior given certain scenarios; it did not measure actual compliance. Partially in response to the results of that study, it has been hypothesized that a lack of information is not necessarily the only limiting factor in complying with specific low-impact recommendations. We propose a four-stage model of factors that might help to explain some noncompliance with backcountry low-impact recommendations where information is not the limiting factor.

The study of noncompliance with low-impact recommendations may be useful on any number of fronts. Certainly, there is the issue of natural resource degradation from recreation impacts. Soil and vegetative impacts from improper camping techniques or inappropriate trail behavior are all important concerns. Similarly, inappropriate behavior during camping or hiking experiences can lead to impacts on wildlife and water resources. Of course, resource impacts are not the only issue of concern—social impacts too may result from noncompliance with low-impact recommendations. A host of visitor experience issues might arise, such as camping too close to other parties, to the trail or to water can all affect visitor experiences. Issues such as crowding and solitude can be affected by noncompliance. Additionally, improper disposal of human waste can be both a health hazard and can result in a negative recreation experience. Finally, managerial and policy issues might arise as a result of noncompliance where certain areas may be closed or restricted to use due to complaints from other users or severe resource impacts.

Overall, the proposed four-stage model should be viewed as an opportunity to understand the social and psychological processes at work within the recreational setting, particularly as they relate to choice and decision factors. This suggests that a number of factors influence our decisions and, ultimately, our behaviors. The purpose of the current research (No. INT-97068-RJVA) is to "develop a better understanding of the factors that limit the ability of visitors to perform low-impact behaviors". Four specific objective were stated for this research :

1. the development of a model describing the cognitive and social psychological processes that underlie the adoption, or failure to adopt, low-impact behaviors;
2. the development of appropriate methodologies for investigating hypothesized cognitive processes;
3. the identification of factors that could potentially limit or constrain the practice of low-impact behaviors; and
4. trial thinkalouds to validate the multistage model.

CURRENT APPROACHES

Fishbein and Ajzen's (1975) Theory of Reasoned Action (TRA) has been widely used to explain behavior in terms of intentions. However, we recognize that a host of other factors may intervene prior to intention that will subsequently affect behavior. Petty and Cacioppo's (1981) Elaboration Likelihood Model (ELM) acknowledged that certain psychological constructs, such as motivation and ability to process information, may affect an individual's attitudes, which in turn, may affect an individual's intentions toward behavior. Each of these examples can be used in the context of noncompliance with low-impact recommendations. With the TRA, we can envision a situation where one's own attitude toward some behavior outweighs a corresponding subjective norm, resulting in noncompliance with some low-impact recommendation. Similarly, under the ELM, an individual may be exposed to some low-impact recommendation through written media on a bulletin board, and, indeed the individual can be considered knowledgeable of specific low-impact recommendations; however, he or she lacks either the motivation or the ability to process that information. The end result in this situation might also be noncompliance. The four-stage model we propose uses the foundations of both the TRA and the ELM, however, we attempt to specify certain sub-categories.

FOUR STAGES OF DECISION MAKING FOR LOW-IMPACT BEHAVIORS

While both the TRA and the ELM offer ways of examining factors that ultimately affect behavior, our proposed model focuses more on the cognitive processes and social forces that affect decision-making. The first stage of our model focuses on the interpretation of the situation. At this level we are interested in perceptual abilities and familiarity with the meanings environmental stimuli. The second stage of the model examines information retrieval strategies. At this level our concern is the accessibility and categorization in memory of attitudes, information and beliefs about low-impact behaviors. Moving to the third stage, judgment formation, we are primarily interested in the ethics that guide behavior choice. In the final stage, expressions of behavior represent a final decision-stage with explicit social factors that link behaviors with perceptions of other people. Factors such as social identity guide behavioral decisions, in that, in some instances people perform behaviors so as to be consistent with some positive social identity. Many of the processes in these four stages of decision making have been investigated in the fields of cognitive and social psychology (tourangeau, 1984).

Cognitive psychology is an approach to psychology that emphasizes the study of mental processes (Goldstein, 1996); specifically it is concerned with mental processes involving perceptions, pattern recognition, memory retrieval, decision- making and judgment. Some cognitive functions that might come into play in noncompliance situations are a failure to recognize the need for a low-impact decision, misidentification of environmental cues and an inappropriate recommendation retrieved from memory. Social psychology deals with situations where the attitudes, beliefs and behaviors of other people affect our own attitudes, beliefs and behaviors. Much social psychology research "has been framed in terms of conformity" (Eagly and Chaiken, 1993) and thus is well-suited to studying issues of noncompliance. In the context of following low-impact recommendations, social psychology might deal with those situations where our camping or hiking companions somehow influence our decisions, judgments and expressions of behavior leading to noncompliance.

Thus, knowledge of appropriate low-impact recommendations is not necessarily the only limiting factor in compliance. Cognitive and social factors can intervene between identifying the need for low-impact practices and, ultimately, practicing the correct behavior. Where recreationists are aware of and have a favorable attitude toward specific low-impact recommendations, other intervening factors, such as group influences, may occasionally prevent compliance.

This model identifies four distinct stages. However, each of the stages relates to at least one of the other stages. Thus, our four-part model details the interconnectedness of each of these parts, and each of these parts is outlined in the paragraphs that follow.

i. Interpretation of the Situation

The first stage of the model is what we have labeled Interpretation of the Situation. At this stage, recreationists must scan and interpret the physical and social conditions of an area. In this sense, they must be able to identify resource impacts and how other people may or may not affect the recreation experience. A problem occurs when people are unable or unwilling to correctly identify salient physical and social features of a site.

On the one hand, people can misinterpret certain environmental cues that are critical to identifying low-impact recommendations. For instance, when trying to select a campsite, campers might first try to determine the amount of use a site receives and thus the need for low-impact practices. How do they determine whether a site receives low, medium or high use based on visible impacts? This can be very challenging task even for moderately experienced campers. Keep in mind that this is just the first stage in our four-stage model. Unless

something in the physical or social environment triggers the need to choose and implement a low-impact practice, recreationists will not enact a low-impact behavior.

ii. Information Retrieval Strategies

Concomitant with interpreting the situation comes identifying the need for a low-impact decision, and thus occurs very early in this four-stage model. However, correctly identifying the need for a low-impact decision does not ensure that one will be made. Of paramount concern at this stage is the ability to retrieve salient information about low-impact behaviors from memory. In short, how accessible are our attitudes, information and beliefs about low-impact behavior? Even though we may assume that wildland visitors are well-informed about correct low-impact behaviors, we should not assume that knowledge is completely and accurately retrieved from memory. One way in which a failure in memory may occur is when individuals may be relying on a heuristic, or shortcut, for information retrieval.

According to Taylor and Fiske (1978), we are all "cognitive misers," meaning that we do what we can to simplify mental processes. A heuristic is one method of simplifying mental processes, and one type of a heuristic is the availability heuristic. An example of this might occur when an individual is attempting to recall the appropriate behavior for more than one person walking across a trail-less open area. One low impact recommendation is for the individuals to spread out, so as to disperse their impacts. However, an individual's most frequent (and hence most available) memory is that of hiking single file, and this becomes their chosen behavior. In this scenario, the individual correctly interprets the situation as one in which a low-impact behavior is appropriate. Further, he or she identifies the need for a low-impact behavior. However, the behavior accessed from memory is not appropriate given environmental conditions. Thus, incomplete or inaccurate retrieval of memory can result in a choice of inappropriate low-impact behavior.

Another way to look at the role of information retrieval strategies is through certain choice rules. Psychologists have distinguished two broad categories of choice rules: compensatory and non-compensatory rules. Abelson and Levi (1985) extensively detail each of these rules. Briefly though, compensatory rules are those where individuals are allowed to adjust and make trade-offs among attributes. Non-compensatory rules do not allow trade-offs between alternatives.

It is worth mentioning that a great deal of cognition research is based on consumer decision-making; the same is true for these two types of choice rules. Studies of choice rules often place individuals in situations in which they are asked to choose one product from two or more alternatives based on a number of different product criteria (for example, cost, features,

functionality, etc.). It seems reasonable that many of the low-impact criteria, such as all of those associated with campsite selection, should be substitutable for product-related criteria. An additional point worth mentioning is that all choice rules serve as models only among situations with well-defined alternatives (such as, Campsite A, Campsite B, Campsite C, etc.). In this respect, recreationists must be able to identify and apply the same criteria across each campsite. Similarly, a great deal of study has been given to decision-making in situations in which the alternatives are not so clearly defined (Tversky and Kahneman, 1982).

iii. Judgment Formation

How do individuals ultimately act in response to their attitudes, memory, environmental cues and judgments? A number of factors influence our judgments. For example, cognitive (What do I remember choosing last time?) and social-psychological (What would someone important to me choose?) factors direct the decision about the correct behavior.

A critical aspect of choice of behavior is one's ethics. Different models of ethical decision-making exist, such as an ethic of justice and an ethic of care. An individual might act according to an ethic of justice if he or she is concerned with equal treatment. In deciding which campsite to select, for example, visitors may make different judgments depending on the ethical framework underpinning the decision. An ethic of justice would encourage protection of the environment as the right thing to do, giving equal protection to the different locations under the specific legal designation of nature preservation. Justice-based reasoning would suggest all campsites should be considered equal regardless of their current environmental condition or level of use. They are all designated as deserving of protection and thus equal protection. In contrast, care ethics urge not equal treatment but equal consideration. The context of each campsite is considered and the potential for a virtuous relationship between the visitor and the particular situation points towards actions that limit impacts to all considered campsites.

Ethics are important foundations of human behavior and represent how the world ought to be. As a result, human behavior is guided and appraised by ethical standards. The rightness or wrongness of particular actions, the virtue or vice of motives which prompt those actions, and the praiseworthiness or blame of the actors carrying out those actions are all ethical judgments. low-impact behavior recommendations are, themselves, ethical guidelines and may be consistent and suggested by either an ethic of care or a justice ethics. However, there may be times when the behavior suggested by a person's dominant ethic runs counter to

low-impact practice. In these circumstances, compliance with low-impact recommendations is unlikely given the foundational and deeply held nature of ethics.

iv. Expressions of Behavior

At this stage of the model, an individual attempts to determine which behavior is most appropriate within the context of both social and environmental factors. Social pressure and social identity come into play, whereby the individual weighs the appropriateness of his or her decision with the image he or she will project to others. This harks back to the Theory of Reasoned Action, in which a subjective norm is one factor that influences behavioral intentions. An example of the Theory of Reasoned Action at work in a questionnaire item might be using a Likert scale to respond to the following statement: "Most people who are important to me think that I should follow low-impact recommendations at all times."

A specific example of the phenomenon of social identity might be a rock climber who wants to be seen by other climbers as environmentally conscious. His or her behavior is adjusted to be consistent with that image. This climber might go to great efforts to project an "environmentally conscious" image in the presence of other climbers. While the ultimate result of this climber's efforts might be consistent with low-impact recommendations, his/her motivations for following these recommendations are not rooted in any desire to protect the environment. This is important, because in situations where there exists no motivation to project an "environmentally conscious" image, no intention to behave appropriately will be there either.

Specifically, if a recreationist believes that certain behaviors will not be sanctioned by the rock climbing community, there is little normative pressure to comply with a recommendation. If we do either more or less than is required of us, we can be held accountable for the consequences, but not otherwise. So the burden then shifts to communicating clear and precise low-impact recommendations to minimize any ambiguity about what is expected of recreationists.

Finally, there undoubtedly are situations in which an individual correctly interprets the situation, correctly recalls a recommendation from memory, and the appropriate course of action is clear, yet, this individual still fails to put into practice the appropriate behavior. At this last stage of the model, a range of factors might make compliance with low-impact recommendations difficult or impossible to follow. It is easy to imagine a backpacker who, faced with fatigue or bad weather, decides to set up camp in a less than ideal spot, even though he or she knows better. It also may not be physically possible to carry out "correct behavior"—such as when the only reasonably flat area for camping is within 100 feet of an alpine lake.

SO WHAT?

Over 2,000 years ago, Plato developed the term *akrasia* to describe a weakness of will that causes people to do what they know is not right. This concept applies to some situations of noncompliance where people correctly identify appropriate low-impact behavior but fail to carry out this behavior due to convenience or expedience. However, this only represents some instances of noncompliance that occur after cognitive and social psychological evaluations have been made. As illustrated by the first three stages in the model, there are a host of factors, such as situation interpretation, information retrieval, and judgment formation that might limit compliance with low-impact recommendations.

A better understanding of the factors that may limit noncompliance will lead to more effective strategies in behavior modification. Depending on which of the four factors is limiting compliance, managers or community groups might apply different persuasive strategies. For example, if correct interpretation of the situation seems to be problematic, perhaps managers could pursue educational efforts that very clearly illustrate techniques in reading the environment. In those scenarios where individuals seem to have a problem correctly retrieving information from memory, managers could take steps to clarify recommendations and perhaps make sure that these recommendations are introduced through the central route. Where ethics are somehow inconsistent with a proper judgment, perhaps the groups responsible for communicating these messages should redouble efforts at consolidating a cohesive set of outdoor ethics. Finally, where appropriate behavior somehow falls short, even where judgments are successfully interpreted, retrieved and formed, perhaps managers should clarify and emphasize the importance of following low-impact recommendations 100% of the time.

It should be noted that this model remains theoretical at this point. What remains to be done is to evaluate the validity of the model. Indeed, decisions about what exactly qualifies as noncompliance must be made prior to any evaluations of the model. In this respect, it must be very clear what constitutes noncompliance. Is noncompliance a gross disregard for all low-impact recommendations? Or, rather, does noncompliance result when just one recommendation is not followed? Or, perhaps, true noncompliance can only be examined in terms of intention? Answers to these questions must be obtained before any model testing can proceed. However, we suspect a combination of observed behavior coupled with self-reporting will either support or refute the model. The idea is to emphasize different aspects of the model

and measure changes in behavior and self-reports. Ultimately, it is hoped that this model will help to clarify subtle distinctions in the reasons for some people failing to practice low-impact behaviors when knowledge of those behaviors is not the limiting factor.

The use of cognitive protocols, or thinkalouds, will aid in documenting the cognitive processes used to make low-impact decisions. Thinkaloud procedures are used by researchers to learn how people interpret a decision making context, how they retrieve information for that decision, form judgments, and express or act upon their decision (Sudman, Bradburn & Schwarz, 1996). Popularized by Ericsson & Simon (1993) and Schwarz & Sudman (1995), verbal protocols / thinkalouds focus not only on the alternative selected in the decision making, but also on the cognitive methods used to select them. Subjects are asked to think aloud as they face the decision context and tell everything that comes to mind as they make the decision. The methods do not so much rely upon the subjects being able to recognize their own cognitive processes, but rather on their ability to report what they are thinking about such that researchers can then recognize or infer the processes used. Sudman et al. (1996) report that "there is no evidence to suggest that respondents report retrieving information that they did not actually retrieve" (p. 39). However, Dillman (2000) recommends the use of both concurrent and retrospective thinkalouds to more fully document the shortcuts and omissions made by respondents.

The potential use of thinkalouds for documenting the decisions surrounding low-impact behaviors is discussed in one of the final chapters of this report. While showing good possibility, further work is needed to refine and successfully apply these techniques to low-impact practice contexts.

Chapter
2

INTERPRETATION OF THE SITUATION

DEFINING A SITUATION

The need for a decision

The approach in this section will be on factors that influence and guide the initial processes of decision-making. In general, a number of cognitive factors will be examined. Some topics to be discussed are: defining a situation, making judgments, process decision models, and satisfactory versus optimal choices. While these factors guide some of the primary discussions in this section, a number of supporting factors will also be introduced. This chapter can be viewed succinctly as a series of responses to the question, what processes are invoked during the initial course of decision-making?

In this chapter, the term information will be used quite frequently. The term can be viewed in a number of different contexts: past experience, environmental stimuli, cues, and even attitudes as they all function as a type of information in the decision-making process. Whenever called for we will distinguish in which context the term information is being used. In general, the overall interpretation of the situation is our focus in this chapter. From first identifying the need for a decision to making use of various forms of information to comprehending the task at hand, our discussion will borrow heavily from the field of cognitive psychology.

Abelson and Levi (1985) defined decision as "cases in which individuals act in the service of preferences" (p. 231). It is this definition we will follow throughout our discussion on decision-making. Our first issue of concern is identifying the need for cognition. In this respect, we're concerned with when individuals know whether or not a decision is warranted.

In low-impact situations, we are concerned with whether or not individuals recognize a need to make a decision towards practicing low-impact recommendations or if the situation in question does not require a decision. A number of factors can influence whether or not an individual identifies the need to make a decision.

To begin with, perhaps certain environmental cues prompt the individual towards a decision. At this stage we are dealing primarily with perception. With respect to a muddy section of trail, is this muddy patch a significant cue to trigger a cognitive assessment of the situation that then prompts the individual to make a decision to follow a low-impact recommendation by walking through the muddy section, or is this cue largely ignored as a matter of routine and the individual skirts the muddy section without coming to a real decision at all? One way of examining the relationship between identifying the need for a decision and certain environmental cues that might prompt that decision is the signal detection theory.

Signal detection theory was proposed in response to military training where radar technicians had to correctly identify visual stimuli on their radar screens. In low-impact scenarios, we would likely be most concerned with whether or not people could identify the appropriate stimulus, such as fragile vegetation, bare ground, or presence of wildlife. The basic premise of signal detection theory assumes that there is a two-way decision with four possible results. Typically we are concerned with a response scenario, which can be translated into "Yes" = present and "No" = absent. Likewise, there are two possible stimuli scenarios: "Noise" = no stimuli and "Stimuli" = presence of stimuli. Figure 1 illustrates this relationship.

	Noise	**Stimuli**
NO	Quiet	Miss
YES	False Alarm	Correct Detection

Figure 1: Standard variables explaining the Signal Detection Theory.

The "Quiet" box represents a situation where the individual *correctly* observes that there is no stimulus when in reality a stimulus is absent. The "Miss" box represents a situation where the individual *incorrectly* observes that there is no stimulus when in reality a stimulus is present. A "False Alarm" represents a scenario where the individual *incorrectly* observes a stimulus when in reality a stimulus is absent. Finally, a "Correct Detection" occurs when the individual *correctly* observes a stimulus when in reality a stimulus is present.

Once again, to use a specific example of a low-impact behavior we can see the connection. Suppose our behavior is campsite selection where a host of criteria should be employed to optimally choose a campsite. One of these criteria is the likelihood of disturbing wildlife. This criterion might be derived by visually observing or hearing wildlife in the area or perhaps observing fresh signs of wildlife (scat, rubbings, tracks, etc.). Any one of these could serve as our stimulus or signal. For illustrative purposes we'll choose observing animal tracks as a stimulus. Figure 2 illustrates how animal tracks might be plugged into the model.

	No Tracks	Tracks
NO	Correct identification of a good campsite	Incorrect identification of a bad campsite
YES	Incorrect identification of a good campsite	Correct identification of a bad campsite

Figure 2: Using presence/absence of animal tracks and Signal Detection Theory to identify good or bad campsites.

Consistent with all examples of the Signal Detection Theory, only two of the four possible outcomes result in good or correct decisions. In this example, the two correct decisions would be either correctly selecting a good campsite or correctly identifying a bad campsite. The situation in which our camper correctly identified a good campsite resulted because he/she searched for tracks, but none were present in reality. In this situation, our camper would presumably select this site to set up camp, assuming all other variables were similarly acceptable. Further, our camper correctly identified a bad campsite because he/she searched for tracks and actually found some. In this situation, our camper would presumably continue searching for an acceptable campsite as the presence of animal tracks would eliminate this one from consideration.

It is worth noting here that particular to the previously mentioned campsite selection scenario several different criteria or stimuli would have to be considered before a campsite would ultimately be selected for use. Thus, searching for animal tracks would represent just one of these criteria. Others that might be considered are distance from water, potential to disturb other campers, fragility of vegetation and soil, etc. As most low-impact behaviors are similarly complex, a host of criteria or stimuli would likewise be considered for each under the signal detection theory. So, the question then arises whether or not individuals would

systematically process each criterion in a signal detection scenario or would this task prove too complex? This issue of task complexity will be revisited later in this chapter.

A second level to an overall interpretation of the situation is the process of making a judgment. In the previous section we discussed how signal detection theory can be used to define certain situations. In this section we are concerned with how recreationists come to specific judgments when confronted with various stimuli. As with the signal detection theory, environmental cues can be considered a primary class of stimuli. Social judgment theory is the first of two methods we will use to understand the process of judgment formation.

Social judgment theory combines the influences of environmental cues with an individual's prior attitudes about an object in order to form a judgment. This theory attempts to describe how individuals react and adjust to an ambiguous environment that follows the rules of probability (Hammond et al., 1975). Individuals who adjust to their environment "must draw correct inferences from observable data, or cues" (Abelson & Levi, 1985, p. 236). Specifically, Abelson and Levi go on to say the individual "must correctly judge the relation between observable, or proximal cues (e.g., the types of clouds in the sky) and unobservable, or distal criteria (e.g., the likelihood of rain) (p. 236).

Attitudes are important here because they can act as a filter of information. Based on prior exposure to certain stimuli, specific attitudes might have arisen. For example, an individual who uses animal tracks as an environmental cue might develop an negative attitude to the relationship between animal tracks and the actual presence of those animals if he or she never sees or hears animals after seeing their tracks. In this respect, this individual would discount the probability of encountering an animal simply based on viewing tracks, and in return he or she might rely on a different environmental cue to evaluate the criteria of "likelihood of disturbing wildlife."

However, as noted by Brehmer and Slovic (1980), often many cues are inter-related and understanding which cues should be attended to and which should be discounted is a critical step in making correct inferences. Additionally, their multiple-cue probability learning concept is concerned with the feedback that individuals receive from their use of cues to help them learn about their environment. So, identifying a good campsite involves a number of criteria and based on prior experience individuals have learned that some criteria are more applicable in campsite selection than others. Abelson and Levi (1985) put it succinctly when they stated that "ecological validity, the true relation of environmental cues to the criterion, parallels cue utilization, the relation of environmental cues to the subject's judgment or

inference" (p. 236). To this extent, individuals learn to recognize which cues are most relevant to whatever criteria they are most interested in.

Linear models, the second method we will explore, are another popular method to study human judgment. These models consist of two elements: component variables and corresponding weights. A component variable is an informational item, possibly in the form of an environmental cue that is combined with all other relevant items to form a composite (e.g., all factors that should be considered when selecting a campsite). So, component variables for campsite selection might include flatness of site, presence/absence of wildlife, high vs. low use area, degree of previous use (site by site basis), proximity to water, etc. Weights can be viewed as measures of importance or relevance given to each component variable. Using our example of campsite selection, a recreationist would prioritize with weights, each of the attributes that contributes to a decision in this event situation. So, a recreationist might assign a high weight to flatness of site (for comfort's sake) and a lower weight to presence/absence of wildlife if he or she doesn't perceive disturbance to wildlife to be a critical factor, or at least as critical as his or her comfort. A composite evaluation for the event of campsite selection would be obtained by multiplying each component variable by its corresponding weight and then summing all the products.

Some perceptual research has been conducted on the relationship between objective and subjective component weights. Researchers have found that in some instances the objective component weights (determined by linear regression) do not match with the subjective weights as stated by individuals. The more closely objective weights correspond to subjective weights is assumed to be an indication of the individual's insight into his or her own evaluation of cognition. In essence, some people in some situations subjectively assign different weights to components than weights that are revealed during an objective analysis. So, a linear model might only be effective for those individuals who have a good understanding of their behaviors.

From the first exposure to a stimulus, possibly an environmental cue, to the ultimate judgment based on the stimulus, a number of additional factors contribute to this process. In fact, viewing decision-making as a process is critical to understanding how some of these other factors affect cognition. Process models are concerned with things like attention levels, heuristics and what information is attended to among other things. Additionally, we'll examine the issue of choice in decision-making, where individuals may select from a range of options. And this is important for many recreational events where freedom to choice and a range of opportunities are often of paramount importance.

Attention levels are variable across different decision-making scenarios. Specifically if the individual does not feel that the decision is of much importance, then his/her attention might be lower than otherwise. Thus, if a backpacker doesn't place much stock in the footwear worn around the campsite, he/she likely will pay little attention to how the footwear might affect the vegetation and soil in and around the campsite. An heuristic refers to a rule of thumb that decision makers employ to facilitate the cognitive process. In a decision-making situation, an availability heuristic refers to situations where an individual recalls from memory situations that are similar to the decision in question. The individual then uses these recalled situations to make a decision in the current context. Research has shown that this decision process can be faulty particularly when it involves choosing between two items, one of which is similar to a number of stored memories and one that is not. In this situation, the individual might opt in favor of the item for which there are accessible memories. An example of this might be when hiking with a group off-trail. An individual might have easily accessible memories of people hiking single file and thus, this would be how that individual would hike. Even though a low-impact recommendation would have groups of people walk spread out, if the individual is not aware of this recommendation and the most readily available image is of people hiking single file, then this might help explain non-compliance. The influence of heuristics and other choice rules will be further discussed in the judgment section of this report.

Even in situations where the decision-maker is not concerned with the cognitive cost of thinking, there are still a number of factors that may inhibit effective decision-making. At least three of these factors might influence a failure to comply with low-impact recommendations. The first factor that might arise is defining what information is relevant to make the decision in the first place. When selecting a campsite, what information should be considered? To this end, some people may not be aware of the criteria that distinguishes a good campsite from a bad one based on low-impact recommendations. A second factor that individuals face concerns how relevant information is obtained. Assuming an individual is familiar with the criterion of disturbing wildlife as one consideration in selecting a campsite, he/she may not know how to go about gathering the information to determine if wildlife might be affected. A third factor is how all the relevant information is integrated into the decision process. For instance, an individual may be aware of the different criteria to consider when selecting a campsite. And he/she may know how to gather the relevant environmental cues to support each criterion. However, it may not be clear how all of the information should be considered. Are all criteria to be treated equally or are some criteria more relevant than others?

Is the overall use level of the area the most important factor or is the environmental condition of the potential campsite, or are all factors equally important?

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Chapter
3

INFORMATION RETRIEVAL STRATEGIES

CURRENT APPROACHES

Having identified the need for a decision, backcountry visitors must then rely on their cognitive capacities to determine what possible actions are available to them. The retrieval from memory of information relevant to the context has been widely studies, partially because this stage is often believed to be most open persuasive arguments. Fishbein and Ajzen (1975), for example, identified beliefs, attitudes, intentions and behaviors all as possible targets of a persuasive communication. The purpose of this section is to review the current dominant approaches to the study and understanding of the persuasive process. The following section will contrast these primarily social influences with the understandings and approaches from a cognitive psychology point of view. In each case, implications for low-impact practices will be discussed, since the persuasive process focuses on organization and influence of information, such as previously formed attitudes, on the behavioral process. The question of retrieval of information is as much a question of what information is remembered (eg. attitudes) as it is about the way that information is stored and accessed (eg. cognitive structures).

Much of the literature on persuasion theory in psychology has focused on attitudes, their recollection, and their influence on behavior. As Manfredo (1992) suggests, "psychologists no longer question whether or not attitudes cause behavior" (p. ix). Attitudes are one of the most important types of information in memory and the accessibility, influence, and process by which attitudes influence behavior are the focus in this section.

A. Theory of Reasoned Action

Description of the Concept

Attitudes have been a continuing source of research in the field of behavior change, in that attitudes are assumed to motivate behavior. An attitude, according to Eagly and Chaiken (1993), "is a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (p. 1). Attitudes are not born out of nothingness, they develop in response to an individual's evaluation of a situation. In turn, this evaluation is based on some degree of information that the individual possesses. It is this relationship between information, attitudes and behavior modification that we will first explore in the following model.

Attitudes first received widespread attention in the 1950's in an attempt to link informational beliefs to attitudes. The extended assumption was that if attitudes could be used to help explain behavior, then corresponding beliefs could be used to predict attitudes. Martin Fishbein (1961, 1963) further refined this notion and his work in turn, led to one of the most often used models (figure 3) that links beliefs, ultimately with behaviors (Fishbein and Ajzen, 1975).

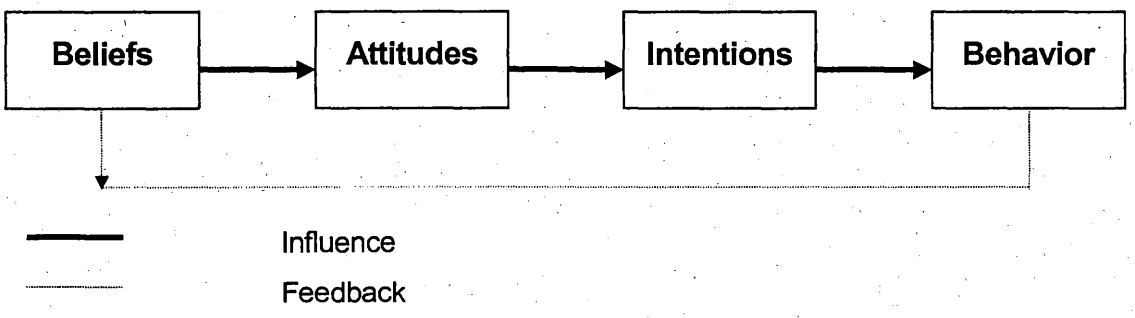

Figure 3: Simplified adaptation of Fishbein and Ajzen's (1975) conceptual framework linking beliefs, attitudes, intentions and behaviors.

Of critical importance in this model are attitudes and the role of attitudes leading to behavior that we will explore further. Attitudes, unlike actual behaviors, cannot be directly observed. To wit, attitudes are said to be inferred between an observable class of stimuli and an observable class of responses. Both the observable class of stimuli and the observable class of responses can be subdivided into three classes: cognition, affect, and behavior. For example, an individual can gather three types of information about an attitude object and can

respond in three different ways to that attitude object. Figure 4 represents a modified conceptualization of two models by Eagly and Chaiken (1993). Attitudes are seen as the channel through which information about the world is channeled into action.

This means that an individual can collect three types of information about an object: cognitive information (what he/she thinks about the object), affective information (what he/she feels about the object), and behavioral information (what he/she experiences through exposure to the object). However, it should be noted that neither all three classes of stimuli nor responses need be present for all attitudes (Zanna and Rempel, 1988). For instance, an individual's negative attitude on the sport of horse racing may result solely from affective stimuli—he or she feels the sport is cruel to horses, and the influence of other information or experience with the sport is low. This distinction is of critical importance in our efforts to understand attitude induced behavior change because attitudes do not necessarily result in a behavior.

Another added dimension to the attitude—behavior link is the relative strength of the attitudes. Fazio (1986) proposed that the stronger an attitude, the more likely that attitude is to affect consistent behavior. So, if an individual possesses a very strong attitude about recycling, he or she is more likely to perform that behavior on a consistent basis. Whereas, an individual who does not hold such a strong attitude towards recycling will be less likely to perform that behavior on a consistent basis.

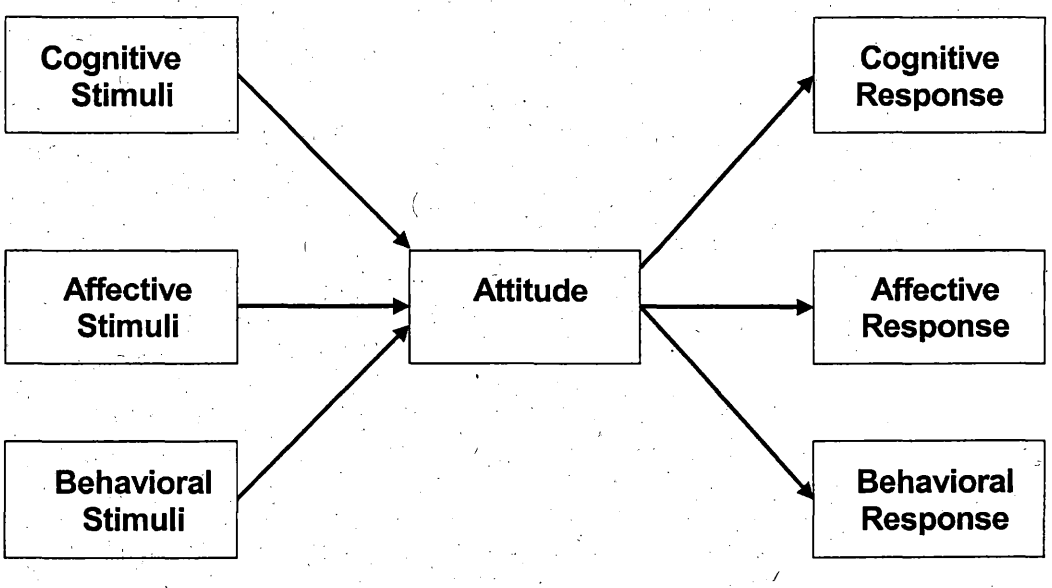

Figure 4: Modified conceptualization of three classes of stimuli producing an attitude leading to three corresponding classes of responses (Eagly and Chaiken, 1993).

While it has not been established without doubt that attitudes definitively lead to behavior, a great deal of evidence has been gathered that suggests a very strong relationship. And it is on the basis of this strong relationship that attitudes might prove to be a useful tool in understanding why some people choose not to follow low-impact practice recommendations.

Petty, Cacioppo, and Goldman (1992) state that attitudes have gained such an important position in social research because of the widespread "assumption that a person's attitude is an important mediating variable between the acquisition of new knowledge, on the one hand, and behavioral change on the other" (p. 78). That is, attitudes affect the influences of (or rememberance of) new information. As we focus on the phenomenon of behavior change, we'll return to the aforementioned models linking attitudes to behavior, and our specific concern is primarily with how attitudes might influence the practice of low-impact behaviors. It follows that if attitudes are a valuable tool to explain behavior in a general sense, then we should be able to use proven research techniques to examine why people don't consistently perform recommended low-impact behaviors, based on their attitudes. While Eagly and Chaiken (1993) reiterated that "attitudes represent only one of several important classes of variables that guide overt behaviors" (p. 155), it appears that there may be some promise in exploring the role of attitudes and low-impact behaviors.

As previously mentioned, attitude-induced responses can take on one or more of three different forms: cognitive, affective, or behavioral. Millar and Tesser (1986) suggested that the variation between these three classes may explain some of the variation of consistency between attitude and behavior. To wit, attitudes that developed primarily through a cognitive route might lead mainly to cognitive rather than affective or behavioral responses. The implication for low-impact practices being if a behavioral stimulus did not contribute to the formation of an attitude, then a behavioral response may not be forthcoming. Further, Eiser (1987) theorized that behaviors might be more consistent with attitude when all three forms of stimuli (cognitive, affective and behavioral) contribute to the development of an attitude.

Perhaps we can use the adoption of Leave No Trace camping techniques as a specific example to further illustrate these points. According to the suggestions of both Millar and Tesser (1986) and Eiser (1987), people will be more likely to consistently follow Leave No Trace ethics if the associative attitudes for these behaviors are acquired through cognitive, affective and behavioral processes. So, making use of all three of these routes would be the key. A specific application of this can be found at the end of this section.

Martin Fishbein and Icek Ajzen have devoted a great deal of their professional careers to research on attitudes. In fact their book, Belief, attitude, intention and behavior: An introduction to theory and research, published in 1975 continues to be one of the most frequently cited works on attitude—behavior relationships. And it is through the efforts of these social scientists that potential applications of attitude research can be applied to low-impact behaviors.

Eagly and Chaiken (1993) summarize several studies that refuted or challenged the suppositions of earlier attitude—behavior research. Of primary concern was the underlying relationship between attitudes and behavior. At least one researcher (Wicker 1969) expressed doubts that there is any true evidence of attitudes affecting behaviors at all. Wicker's criticisms grew from his review of a number of studies in which correlations between attitudes behaviors were relatively low. While many of these criticisms have been addressed in subsequent studies (e.g., Fishbein and Ajzen, 1974; Snyder and Ickes, 1985), Wicker's paper did serve the useful purpose of illustrating some faults in attitude research methodology. Two main areas of concern are a) laboratory vs. survey research, and b) specificity vs. generality of attitudes and behaviors.

It appears that in general, attitude—behavior correlations resulting from laboratory research differ in strength from attitude—behavior correlations resulting from survey research. Eagly and Chaiken (1993) propose the reason for this difference lies in the "tendency for survey research to examine attitudes that are more important and involving and that therefore may be more influential in relation to behavior" (p. 157). Additionally there is some evidence to suggest that the lack of anonymity afforded to subjects of laboratory experiments may inhibit the correlation between attitudes and behaviors (Snyder and Ickes, 1985). In particular when the attitudes at issue are of a publicly delicate nature (such as racism), respondents may be less likely to be truthful or accurate in their responses if they must respond in the presence of others.

In terms of the relative specificity of attitudes and behaviors, Eagly and Chaiken (1993) synthesized several studies to underscore their recommendation that using a class of behaviors may yield higher correlations when comparing an attitude with this class of behaviors. In this sense, attitudes generally show a higher correlation with a class of behaviors relevant to that general attitude than with a single behavior. A successful demonstration of this point was illustrated by Weigel and Newman's (1976) study on environmental attitudes and corresponding behaviors and behavior classes.

An additional implication of this finding occurs if we incorporate the component of intentions into the middle of the attitude—behavior equation. Petty et al. (1992) noted that "unlike intentions to engage in specific behaviors, intentions to reach goals or engage in classes of behaviors do not necessarily lead to accurate predictions" (p. 33). Further, it is very difficult to predict what specific behaviors an individual will perform when he or she responds favorably to a class of behaviors. It is with respect to these issues that the use of attitudes to understand low-impact practices might create problems.

To use a low-impact practices example, an individual may express an environmental consciousness (intent towards a class of behaviors), however he or she might not see a problem with a specific behavior of feeding wildlife. To this person, feeding the wildlife may not be a specific behavior that he or she uses to define his or her environmental class of behaviors. Thus, when querying people on their attitudes to low-impact practices, care must be taken to make sure that attitudes and behaviors are of like specificity. That is to say that general attitudes can only be used in relation to general behaviors, which may be of little value where specific problems are occurring concerning individuals not following a specific low-impact practices recommendation.

This is not to suggest that attitudes might not be at all effective in attempting to understand non-compliance with low-impact behaviors. In particular where attitude research might be quite helpful is in the manipulation of the three types of stimuli (cognitive, affective and behavioral). As previously suggested, combining these three stimuli might create more consistent behaviors (Eiser, 1987). And Eagly and Chaiken (1993) noted that "a largely unexplored issue is the extent to which the cognitive, affective, or behavioral processes by which an attitude is acquired relate to the cognitive, affective and behavioral responses that the attitude object subsequently elicits" (p. 17).

While research on the linkage between attitudes and behaviors did answer some questions, there remained room for further exploration. And in response to some of the unanswered questions from attitude-behavior research came the theory of reasoned action and the complementary theory of planned behavior. Once again Martin Fishbein and Icek Ajzen took the lead in the development of this line of inquiry. These theories were a natural extension of their work on attitude, however with both the theory of reasoned action and the theory of planned behavior, the role of intention became more critical. Intention assumes at least two distinct components: conscious thought and voluntary participation. And as we will explain, both of these components of this theory have different implications for low-impact

behaviors. In this section we will explore both the theory of reasoned action and the theory of planned behavior as both of these theories use to the component of intention as a cornerstone.

To begin with, the theory of reasoned action, as suggested by its name, "rests on the assumption that humans are reasoning animals who systematically utilize or process the information available to them" (Fishbein & Manfredo, 1992, p. 30). Figure 5 illustrates the primary factors that contribute to this theory.

According to this model, behavior is determined by the intention towards that behavior. That intention is determined by the attitude towards that behavior and a subjective norm. Finally, the relative weights assigned to both the attitudinal and normative influences on the intention are factored in. Fishbein and Manfredo (1992) noted some hypotheses that can be used to explain the Theory of Reasoned Action. First, behaviors are directly linked to intentions; and secondly, intentions are directly linked to a weighted combination of attitudes and subjective norms. A third hypothesis relating underlying beliefs to attitudes and norms is not depicted in the above model.

The attitudes considered in this theory are the behavioral attitudes discussed earlier. This is an important distinction in that it relates to our previous comparison between general and specific attitudes and behaviors. Once again, it is important to maintain consistent measures across the model. However, it should be noted that these attitudes do develop from individually held and evaluated beliefs. These are the beliefs that an individual has concerning the outcomes of a specific behavior and that individual's internal evaluation of those outcomes (Ajzen & Fishbein, 1980). Despite the similarity to earlier attitude research, this theory "provides a model of the psychological processes that mediate observed relations between attitudes and behavior" (Eagly & Chaiken, 1993, p. 168).

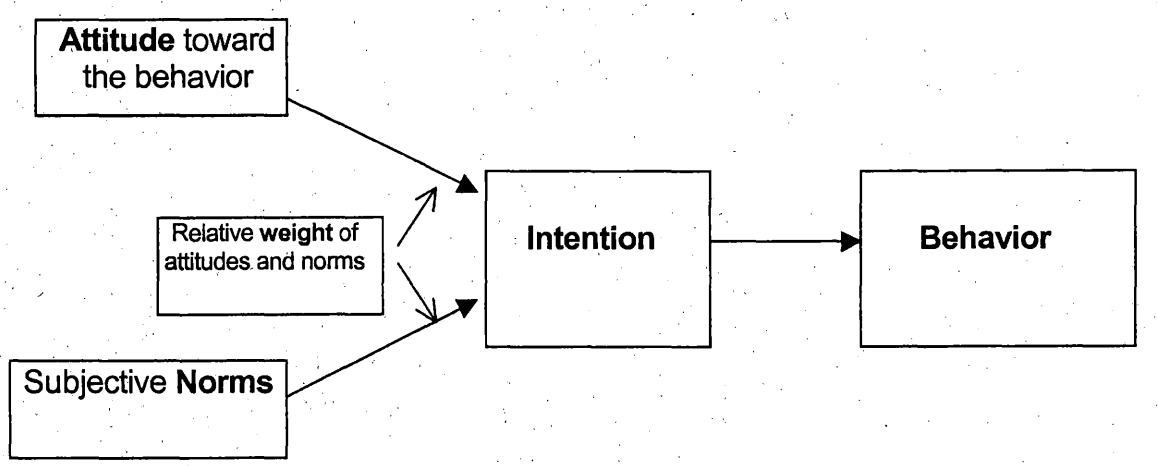

Figure 5: Adaptation of the Theory of Reasoned Action (Ajzen & Fishbein 1980).

A subjective norm is made up of an individual's perceptions about whether significant others believe that he or she should participate in some behavior and the motivation that one has to comply with his or her significant others (Ajzen & Fishbein 1980). In this respect, the Theory of Reasoned Action has included a component not widely considered in the previous attitude-behavior research: the role of social pressure or conformity.

Relative weights exert influence on both the attitude toward behavior and the subjective norm. This component of the model illustrates that in some instances a greater weight may be assigned to the attitude than to the norm and vice versa. This may help explain why two individuals with similar attitudes and overlapping referent groups might not always intend to perform the same behaviors. For example, one person might place more weight on the attitude, while the other person might place more weight on the subjective norm, and the beliefs behind the attitude might be different than the beliefs behind the subjective norm.

Where Ajzen goes further with his theory of planned behavior is in the inclusion of perceived behavioral control. This component acknowledges the importance of voluntary action on the process of intentions to behavior. And the addition of perceived behavioral control is really the only difference between the theory or reasoned action and the theory of planned behavior (Ajzen, 1991). A criticism raised about the theory of reasoned action was that it can only be used to explain behaviors in which the individual has the ability and motivation to perform those behaviors. Ajzen's theory was expanded to include a component that would allow for situations where individuals encounter mediating factors that are perceived (by the individual) to inhibit in some way their voluntary participation. In review of this theory, Mannell and Kleiber (1997) note that "attitudes give rise to behavior only when an individual *perceives the behavior to be within her or his control.* To the extent that people lack confidence in their ability to engage in some behavior, they are unlikely to form an intention to do so" (p. 340). Figure 6 represents Ajzen's (1991) model.

This concept of perceived behavioral control actually impacts every other component of the model, as noted by the influence arrows. Thus, how an individual views his or her control over a situation affects his or her attitudes toward behavior, subjective norms, intentions and finally the actual behavior. Ajzen (1991) felt that this model could be used to explain a wider range of behaviors than those afforded by Fishbein and Ajzen's theory of reasoned action. However, Eagly and Chaiken (1993) point out that while Ajzen believed in the validity of the earlier theory of reasoned action, he felt compelled to expand on the model to include behaviors that are not entirely voluntary.

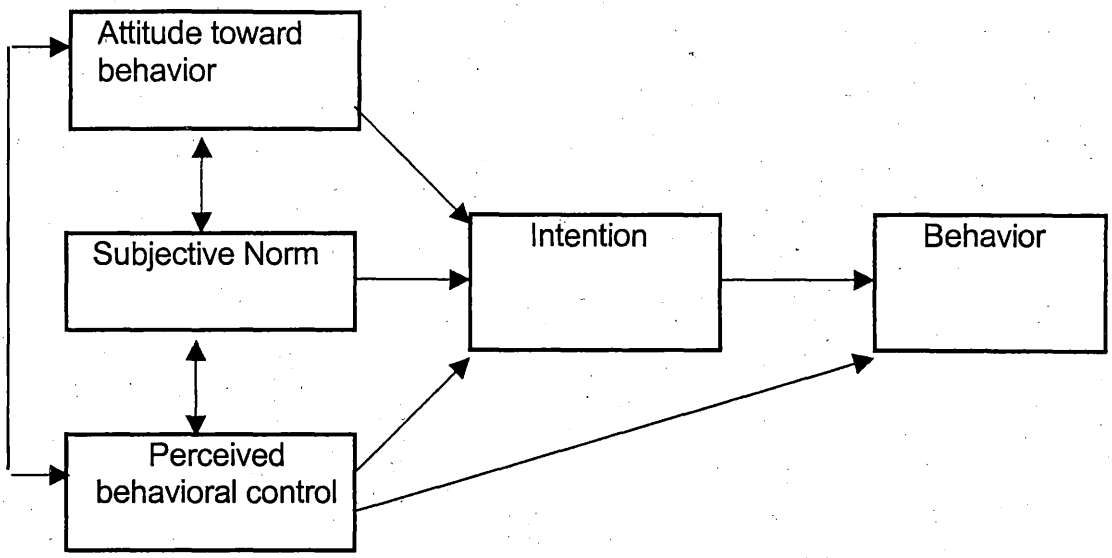

Figure 6: A conceptualization of the Theory of Planned Behavior (Ajzen 1991).

Both the theory of reasoned action and the theory of planned behavior have been widely used by countless other researchers in their efforts to explain behavior (see Eagly & Chaiken, 1993, for a detailed list). And each of these theories might offer some insight into a study of noncompliance with low-impact practices recommendations. Fishbein and Manfredo (1992) have already given an extensive explanation of how the theory of reasoned action has been and could be applied to the general field of recreation research. And McCarville, Driver and Crompton (1992) noted the application of the theory of planned behavior in pricing strategies of public recreation services. It seems logical that each of these theories could be applied to study low-impact behaviors.

When we consider what factors might be important in understanding the process that people go through when they are confronted with a situation that favors low-impact practices, several components of both theories might apply. As previously mentioned, attitudes toward the behavior can be useful. However, it bears mentioning that relative specificity of the attitude is, once again, critical. General attitudes are good predictors of general behaviors and attitudes toward a specific behavior tend to be good predictors of that specific behavior (Eagly & Chaiken, 1993). Further specific behaviors should only be used in correlation to a general attitude when the behaviors are aggregated into an index of attitude-relevant behaviors. Thus, an attitude towards low-impact practices in general must consider some aggregate or composite of attitude-relevant behaviors.

Both the theory of reasoned action and the theory of planned behavior consider the importance of subjective norms as they relate to intentions. Young and Kent (1985) used the

statement, "Most people who are important to me think I should go camping this summer" to measure subjective norms. Once again, these norms must likewise reflect the general or specific nature of the attitude being discussed. So, a question an individual might ask himself or herself could be, "Do important people in my life think I should follow low-impact behaviors?" Conversely, another question might be, "Do important people in my life think I should change my footwear to a light, smooth-soled shoe from a lug-soled boot when walking around the campsite?" Comparing these two questions illustrates how consistency is maintained between general and specific attitudes and their respective subjective norms.

The intention to perform some behavior is the third component shared by both theories. Eagly and Chaiken (1993) define intention as a "person's motivation in the sense of his or her conscious plan to exert effort to carry out a behavior" (p. 168). Fishbein and Ajzen (1975) considered intentions in the form of a person's subjective probability towards participating in some behavior. Regardless of the definition, the important factor is the consistency of specificity between attitudes, subjective norms, intentions and the behavior in question. Thus, a relatively general intention of practicing low-impact behaviors may not be a particularly good indicator of a quite specific behavior of staying on pre-established trails when hiking through a federal wilderness area.

Perceived behavioral control is a component found only in the theory of planned behavior. This component can be viewed as an individual's "perception of how easy or difficult it is to perform the behavior" (Eagly & Chaiken, 1993, pp. 186-187). And this too might be useful in examining failure to comply with low-impact practices recommendations. For example, the search for an appropriate campsite might be mitigated by the encroaching darkness. In this respect, the setting sun can be seen as an external constraint against the successful completion of the behavior of selecting a campsite consistent with low-impact practices recommendations. However, constraints that limit behaviors need not always be external in nature. Internal constraints such as skill level can likewise inhibit behavior.

Although both the theory of reasoned action and the theory of planned behavior have found support among social scientists, each has also received criticisms. Possibly the premier criticism that is shared by both theories is the fact that they exclude a number of factors that other studies have shown to be important in the determination of intentions. At least three additional factors beyond attitudes and subjective norms have been used to improve prediction of intentions: self-identity (e.g., Charng, Piliavin, & Callero, 1988), moral obligation (e.g., Schwartz & Tessler, 1972), and past behavior (e.g., Bentler and Speckart, 1979).

This issue of self-identity might be very important in terms of understanding the practice of low-impact behaviors and whether or not one defines himself or herself as someone with a positive environmental ethic. For example, an individual might consider himself or herself someone who possesses a positive environmental ethic, however some specific low-impact behaviors may not be performed by that person. In a review of a number of other studies, Biddle, Bank and Slavings (1987) noted that "self-identities are both a product of social interaction and a cause of subsequent behaviors" (p. 326). Similar to the issue of general versus specific attitudes, a general self-identity (pro-environment) might not translate particularly well with a specific environmental behavior (feeding wildlife). The influence of social identity will be discussed in greater detail in the chapter on expression of behavior.

In terms of a predictor of behavior, moral obligation may have less to do with low-impact behaviors than some other factors; this, despite the suggestion by Schwartz and Tessler (1972) that moral obligation "may indeed be the most important single predictor of intentions and interpersonal behavior, and not simply an alternative measure of behavioral intentions" (p. 235). Unless, the individual perceives that there is a moral pressure to follow low-impact behaviors, either singularly or as a composite, then this behavior predictor probably is of little value. The distinction should be made here that moral obligation is an entirely different issue than social pressure. Morals and ethics perhaps play their greatest role in the judgment phase of decision-making.

The third additional factor of past behavior may also have some applications to low-impact behaviors. According to Bentler and Speckart (1979), how people have behaved in the past can influence their future behaviors. In this respect, the past decision to camp a certain way may influence a subsequent decision to camp. Specifically, if an individual had not followed low-impact practices camping recommendations in the past, then this past behavior may influence future decisions on how to camp, even in light of new attitudes and subjective norms that support low-impact behaviors. "Apparently, as habit increases, the performance of the behavior becomes less one of a rational evaluation of the consequences of the act and more one of a learned response" (Bagozzi, 1981, p. 625). Thus, attitudes themselves may be of little predictive value when examining behaviors that have occurred consistently in the past. Trafimow and Borrie (1999), for instance, found that previous behavior provides a cognitive prime for future intentions for depreciative behavior in a natural resource setting.

Fazio and Zanna (1981) attributed the influence of past behavior on subsequent behavior to three attitude features: clarity, confidence and certainty. These researchers maintained that the clarity, confidence and certainty of the applicable attitude is strengthened

from past behavior or direct experience. This, in contrast to attitudes that are comparatively weaker in clarity, confidence and certainty resulting from indirect experience, such as reading a brochure. Eagly and Chaiken (1993) summarize this relationship by noting that stronger attitudes stemming from increased clarity, confidence and certainty might be better predictors of behavior.

Implications for Low Impact Behavior

As this concept relates to low-impact behaviors, individuals who have habituated back-country behaviors are more likely to have clearer, more confident and more certain attitudes towards that behavior. Further, Fazio and Zanna (1978) noted that increasing an individual's confidence in their attitudes, possibly through direct experience might strengthen the attitude-behavior correlation. This proposition has both positive and negative aspects in regard to low-impact behaviors. A potential positive implication is discussed at the end of this section. A negative implication for this proposition is that the more frequently a bad behavior is practiced (e.g., placing one's tent in an environmentally delicate area for a long period of time) the more confident this individual becomes that his or her behavior is acceptable and thus more difficult to change.

In order for both the theory of reasoned action and the theory of planned behavior to be effective in explaining low-impact behaviors, a number of assumptions must be made. First, that the behavior in question is deliberate. This aspect of deliberateness involves at least a couple of different levels: that the relevant behavioral information is processed and that this information is evaluated as it relates to outcomes. As suggested by some of the research on past behavior or habituation, it appears that when certain behaviors are practiced consistently fewer cognitive and evaluative processes are followed. And this absence of rational decision-making conflicts with both the theory of reasoned action and the theory of planned behavior. Thus, when attempting to understand why individuals make certain decisions either consistent or inconsistent with low-impact practices recommendations, unless these behaviors stem from a process of rational decision making, neither of the two theories discussed in this section may relate well.

So, how might both the theory of reasoned action and the theory of planned behavior be used when studying low-impact behaviors? Both theories hold promise where specific behaviors are concerned. Attitudes, subjective norms, intentions and behaviors must all be calibrated similarly so that defining limits of action, target, context, and time are consistent across each stage of the models' processes.

Perhaps the most valuable application stems from the criticisms of the theory of planned behavior. The primary criticism comes from the knowledge that past behavior can be a powerful influence on behavior. And further this factor of past behavior can strengthen attitudes in terms of their clarity, confidence and certainty (Fazio & Zanna 1981). As suggested by Petty and Cacioppo (1986), direct experience can enhance the accessibility of attitudes and can therefore lead to a stronger correlation between attitudes and behavior. Thus, individuals who consistently practice improper backcountry techniques might develop strong and accessible attitudes towards this behavior and therefore develop behaviors that are difficult to change. Conversely, for individuals who do not have strong attitudes resulting from habituated behaviors, then giving these people a direct experience of proper backcountry behavior might be a first step towards a positive habituation process. If these novices can be instilled with proper low-impact practices recommendations through a hands-on learning process, then they might be more likely to consistently practice these behaviors.

B. Elaboration Likelihood Model

Description of the Concept

Additional research on the attitude-behavior relationship, in the form of the theory of reasoned action and the theory of planned behavior, acknowledged a number of other factors that may further our understanding of this process. And once again, attitudes continue to play an important role in another model based on cognitive processing of information: the Elaboration Likelihood Model (ELM). Petty et al. (1992) noted that "a person's attitude is an important mediating variable between the acquisition of new knowledge, on the one hand, and behavioral change, on the other" (p. 78). However, this model goes beyond the previously discussed theories in that the factors that influence the gathering of new information rises in importance. With the ELM greater emphasis is placed on the process of gathering or receiving information about an attitude object. Of primary interest are the related factors of motivation and opportunity. To wit, an individual's motivation to gather new information about an attitude object and likewise the opportunity that he or she has to receive that new information are considered. As we will discuss in this section, the combined factors of motivation and opportunity might offer much additional insight into understanding the factors that might limit low-impact behaviors.

The Elaboration Likelihood Model developed by Richard Petty and John Cacioppo attempts to explain how information in the form of persuasive communication can change

one's attitudes. A number of new concepts play a critical role in the explanatory value of this model. Petty and Cacioppo (1986) suggested that individuals interpret persuasive communication through one of two different routes: the central route and the peripheral route.

Petty and Cacioppo (1986b) proposed seven postulates or assumptions of the ELM. These postulates offer some beginning assumptions that the authors have used to begin their model. These seven postulates can be seen in table 1. A basic tenet of the ELM is information about and attitude object can modify attitudes through two routes: central and peripheral. Through the ELM, Petty and Cacioppo (1986) acknowledge that some attitude objects are more critical than others in certain situations. Where an attitude object is more important to an individual, he or she will be more motivated to cognitively process any information relevant to that object. Conversely, where an attitude object is of little importance to an individual, he or she will be less motivated to cognitively process this information. So, some situations call for thorough reasoning and others do not.

Fazio (1990) noted that in situations where deliberate processing of information occurs, "some motivating force is necessary to induce individuals to engage in reasoning" (p. 91). Petty et al. (1992) summed up Fazio's MODE model nicely in saying, "for behavioral decisions that are high in perceived personal consequences, attitudes are likely to guide behavior by a deliberate reflection process; but when perceived consequences are low, spontaneous attitude activation should be more important" (p. 93). Thus, there is something that compels and individual to make good use of available information and process all choice alternatives. Kruglanski (1990) proposed one such answer to this motivation in his theory of lay epistemology. The theory suggests that individuals are motivated to make deliberate decisions (as opposed to capricious or even automatic decisions) in response to a fear of making a mistake. In this respect, an individual would spend a greater amount of time making a decision in situations where a poor decision might result in an outcome with severe or costly consequences. Kruglanski (1990) calls this motivation for deliberate information processing, a "fear of invalidity." In the absence of this "fear", individuals do not have any incentive to expend time and effort cognitively evaluating a situation (Fazio, 1990). As we shall discuss shortly, this compelling urge to do the "right thing", whatever that "right thing" is, has definite implications for the adherence to low-impact practices recommendations.

However, whether or not an individual is sincerely motivated to make systematic use of available information is not the only consideration. Additionally an individual must have the opportunity or ability to process the information. Ability, in this scenario, can mean a

number of different things. An ability to process information can be hindered by any number of factors: distraction, repetition, prior knowledge, message comprehensibility, etc.

Table 1: Postulates of the Elaboration Likelihood Model of Persuasion

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I. People are motivated to hold correct attitudes.

II. Although people want to hold correct attitudes, the amount and nature of issue-relevant elaboration in which people are willing or able to engage to evaluate a message vary with individual and situational factors.

III. Variables can affect the amount and direction of attitude change by: (A) serving as persuasive arguments, (B) serving as peripheral cues, and/or (C) affecting the extent or direction of issue and argument elaboration.

IV. Variables affecting motivation and/or ability to process a message in a relatively objective manner can do so by either enhancing or reducing argument scrutiny.

V. As motivation and/or ability to process arguments is decreased, peripheral cues become relatively important determinants of persuasion. Conversely, as argument scrutiny is increased, peripheral cues become relatively less important determinants of persuasion.

VI. Variables affecting message processing in a relatively biased manner can produce either a positive (favorable) or a negative (unfavorable) motivational and/or ability bias to the issue-relevant thoughts attempted.

VII. Attitude changes that result mostly from processing issue-relevant arguments (central route) will show greater temporal persistence, greater prediction of behavior, and greater resistance to counter-persuasion than attitude changes that result mostly from peripheral cues.

The role of individuals making use of information in a recreation setting has at least been touched on in numerous studies (e.g., Driver & Brown, 1975; Baileschki & Henderson, 1988; Jim, 1989; Heberlein, 1992). While some other studies focused on information as a management tool to redistribute use (e.g., Brown & Hunt, 1969; Lime & Lucas, 1977; Fazio, 1979; Krumpe & Brown, 1982). Although most of these studies use information only in an ancillary context or as a management technique, the importance of the ability of individuals to use available information should not be overlooked. Of primary importance is the recognition that ability to process information is a second hurdle that must be overcome prior to the central route to attitude change. Thus, despite an individual's desire (motivation) to gather and digest information as part of the decision-making process, unless he or she has the ability to process this information as well, then the central route cannot be achieved.

So of what distinction is the central versus the peripheral route to persuasion? "Attitudes formed or changed via the central route are hypothesized to be relatively persistent,

predictive of behavior, and resistant to change until challenged by convincing counter-arguments (Eagly & Chaiken, 1993, p. 306). The ELM suggests that information can modify attitudes in one of two ways: through the central route and through the peripheral route. In reference to postulate VII (see table 1), attitudes that are changed or added through the central route are stronger than those changed or added through the peripheral route. Strength, in this sense, is defined by how easily these attitudes can be subsequently accessed from memory, how long these attitudes last, and their predictability of behavior. Thus, central route attitudes are more easily accessed from memory and for a longer period of time and are greater predictors of behavior, when compared to attitudes that are changed or added through the peripheral route. Adding another layer of discussion to the model, we can manipulate any number of contextual variables to augment either the peripheral or central route.

The variables mentioned in postulate III offer one of the models most interesting characteristics. These variables can be found in the source, receiver, channel and message. In short, any variable found in the communication framework might be applied. And these variables can be manipulated to play different roles: as a persuasive argument, and/or as a peripheral cue, etc. A number of these variables have been successfully tested in support of the ELM: source attractiveness and expertise (e.g., Petty & Cacioppo 1984c), receiver's mood (e.g., Petty, Gleicher, & Baker, 1991), and message quality (e.g., Petty & Cacioppo, 1986). Further, some of these variables will be discussed in more detail in the following section of this report.

Petty et al. (1992) outlined the entire ELM as it might relate to various recreation management situations in which persuasion might be called for (e.g., reducing vandalism, promoting proper behavior in bear country, and increasing visitation to a specific recreation facility). It would appear that following low-impact practices recommendations could similarly be included in this list of potential applications for the ELM. Where the ELM might offer some addition insight into understanding non-compliance with low-impact practices recommendations is in the manner in which low-impact attitudes are formed. Are these attitudes formed as a result of deliberate processing of information (central route) or are they formed as a result of situational variables, such as the number of arguments contained in the message or the expertise of the source (peripheral route)? Depending on the route in which the low-impact attitudes are formed, differing levels of attitude strength and behavior predictability will arise.

Of additional interest might be the relationship between the medium of information (brochures, videos, skills courses, etc.) and subsequent attitude change through each of the

routes. For instance are written low-impact practices recommendations more likely to promote peripheral route persuasion than instructional videos or skills courses? Clearly there are similarities to applications as outlined in the previous section on the theory of reasoned action and the theory of planned behavior. These similarities will be discussed at the conclusion of this section.

Eagly and Chaiken (1993) support the contention that the greatest strength of the ELM is the short list of three ways in which variables can affect persuasion (see postulate III). In this respect, it might be useful to know when the variable of source expertise is acting as persuasive argument, a peripheral cue, and/or affecting the extent or direction of argument elaboration. While Petty and Cacioppo (1986) describe the ELM as "a fairly general framework for organizing, categorizing, and understanding the basic processes underlying the effectiveness of persuasive communications" (p. 125), there is reason to believe that the numerous studies cited by these authors could likewise be used in support of our discussion on non-compliance with low-impact practices recommendations.

While the ELM does offer some additional insight into the attitude-behavior relationship, there remain some criticisms of the model. Eagly and Chaiken (1993) noted that the ELM is "primarily a descriptive, rather than explanatory, theory of persuasion" (p. 321). Further, Petty and Cacioppo (1986) likewise noted that a number of "why" questions are left unanswered with their model. In particular, the ELM does not explain why some variables have different influences (persuasive argument versus peripheral cue) in different situations (low versus high elaboration).

Implications for Low Impact Behavior

Specifically as the ELM relates to the study of non-compliance with low-impact practices recommendations, this model describes how specific variables (e.g., source attractiveness and/or expertise) combined with an individual's motivation and ability to process information can lead to either long-lasting, predictive attitudes (central route), or temporary, unpredictive attitudes (peripheral route). However, one of the first connections that must be made is whether or not centrally developed low-impact attitudes are predictive of low-impact behaviors. There are few, if any, applications using the ELM to study low-impact behaviors. And once again, it would appear that relative specificity of the attitude is at issue. As opposed to the previously discussed models and theories concerning the attitude-behavior relationship, the ELM has as a central focus the gathering of information. And this step is mediated by motivation and ability to process the information. Therefore, any study of the ELM would

have to include a controlled environment in which these variables and others (source attractiveness and expertise) could be manipulated.

Despite this hurdle, a controlled laboratory experiment might be feasible in which individuals were subjected to information on low-impact behaviors, while manipulating a number of variables. A Solomon four-group design might be used to measure differing attitudes held by individuals who are subjected to an information campaign on low-impact behaviors. This design would likewise allow comparisons to be made between those who were not subject to the information campaign stimulus. Babbie (1995) noted that "not only does the Solomon four-group design rule out interactions between testing and the stimulus, it provides data for comparisons that will reveal the amount of such interaction that occurs in the classical experimental design" (p. 246).

C. Source reliability, authority, and likeability

Description of the Concept

Where Petty and Cacioppo's Elaboration Likelihood Model acknowledged the importance of variables in determining successful persuasion through the central and peripheral route, the literature on consumer research has explored source, receiver and message variables even further. The supposition is that the manipulation of these variables can enhance the modification of attitudes. From a purchasing perspective, advertisers employ some of the variables previously discussed: source attractiveness and expertise. It is the use of such that variables that concerns us now. Do manipulations in these variables enlighten us further in our study of factors that limit compliance with low-impact practices recommendations? Can we follow the footsteps of previous researchers and adapt their methodology to study low-impact attitudes? Before answering these questions, perhaps we should first explore the foundations and previous research for these variables.

As previously mentioned, these variables can occur at any stage of the standard communication model: source, receiver, message or channel (Figure 7).

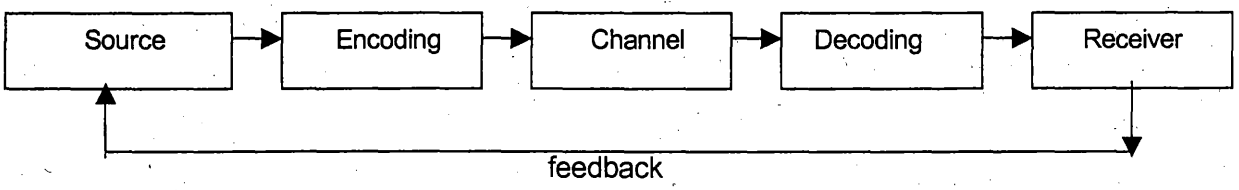

Figure 7: Standard communication process model.

Most research on variables hints at the topic of heuristics, where an individual relies on a rule of thumb to reach a conclusion rather than processing the explicit information (Chaiken, 1987). For example, an individual might rely simply on the expertise of the source rather than the strength of the argument in changing his or her attitude. Another scenario might have the individual using the number of arguments in the message rather than the content of the message to draw a conclusion. Variables within each of the four general areas of the communication model might offer some insight into how attitudes are modified or developed. We'll examine each of these variables in some detail, however, to begin with, let's review some research on source variables.

Extensive research has been conducted on source variables, with perhaps the first serious efforts stemming from Carl Hovland and his colleagues from Yale University in the 1950s. "Source variables are observed or inferred characteristics of the communicator" (Ajzen, 1992, p. 6). Pursuant to our previous discussion of the ELM, attractiveness and expertise are two source variables that have received considerable attention. In addition to these though are other variables such as age, facial expressions, income, and self-confidence. In general, a category called "source credibility" encompasses some of what we've already discussed. Smith (1982) noted source credibility could be viewed as a composite of source expertise, trustworthiness, and attractiveness. Thus, the credibility of the source is dependent on two items (expertise and attractiveness) that were important to the ELM. And McCool and Braithwaite (1992) suggested that a face-to-face contact between a credible agency representative and a visitor might be the most effective way of communicating information on hazards.

Originally, the receiver was viewed as a passive participant in the communication process, however Ajzen (1992) summarized a number of studies that suggested otherwise. In fact, Ajzen (1992) went on to say that "there is every reason to expect that receivers exposed to a persuasive communication may engage in an active process of deliberation..." (p. 12). Because much communication research has been conducted as a component of consumer or marketing research, receiver variables have often been viewed in this context. Some such variables are, receiver intelligence, involvement in the issue and personality traits. Although McCool and Braithwaite (1992) succinctly describe a range of receiver variables, "receiver characteristics include not only previous experience and social-demographic variables, but also normative group influences and cognitive processing" (p. 315). Although consumer oriented studies have paved the way for research on these variables, our focus has touched on receiver variables as well. In particular, Petty and Cacioppo's Elaboration Likelihood Model considers

motivation and ability to process information, and each of these manifests as receiver variables. In fact possibly the most distinctive aspect of receiver variables can be found in the dual factors of motivation and ability to process information. We'll return to this topic later in this section.

Channel variables can be defined as the means or media used to communicate a message (Ajzen, 1992). For example a message that extols the dangers of feeding wildlife can be communicated through a face-to-face interview, watched on a video tape, or read in a brochure. The content of the message remains static through each of the communications, however, the delivery mechanism changes. "Persuasive messages are usually aimed at stimulating a receiver's senses, particularly sight and sound" (McCool & Braithwaite, 1992, p. 314). And McGuire (1985) noted that in some cases individuals tend to remember information conveyed in a written manner better than visual messages, while visual messages are generally better liked. However, Chaiken and Eagly (1976) noted that recipients were more likely to accept an audiovisual argument than a written one. Finally, while face-to-face communication may be the least financially efficient way to convey a message, it appears to be the most effective (Katz & Lazarsfeld, 1955).

The final category of variables concerns the message itself. Variations in the message range from emotional versus non-emotional appeals, ordering of message arguments, and effectiveness of the argument to name a few. It has been proposed that argument effectiveness is a function of at least three factors: argument novelty, argument strength, and argument relevance (Ajzen, 1992). And argument effectiveness is measured by a change in attitude or an adoption of a new attitude. Thus, in order for a communicated message to be able to change attitudes, it must contain some information that is new to the individual, and this new information must also be strong, and the information must be directly related to the issue at hand.

One of the more critical aspects of a message variable is the concluding point. Thistlewaite, de Haan and Kamenetzky (1955) suggested that persuasive communication must do more than simply present arguments, it must offer conclusions. Similar to Freeman Tilden's Fourth Principle of Interpretation which states, "The chief aim of interpretation is not instruction, but provocation" (Tilden, 1977), persuasive communication should challenge the receiver to find meaning in the message. It is this challenge in finding meaning, that can increase personal involvement and in turn increase the motivation to process the information.

While much of the aforementioned research has focused on persuasive communications, an important issue to raise at this point is the distinction between persuasion

and information. Persuasion can and should contain informative elements, however these should not be viewed as similar concepts. In fact, a source who is perceived as having a persuasive agenda is seen as less trustworthy than a source who simply intends to inform (Petty & Cacioppo, 1981). Thus, a distinction should be made in the type of communication being delivered. However, as information and persuasion are not mutually exclusive, this can be a difficult task. In terms of our discussion of low-impact behaviors, there may be opportunities for both persuasion and information, depending on the objectives at the time.

The context into which these four variables relate to recreation has been discussed extensively in a series of book chapters (e.g., Ajzen, 1992; Winett, 1992; Slater, 1992; Knopf & Dustin, 1992; and McCool & Braithwaite, 1992). Consistent through all of these studies is the implied importance of motivation and ability to process information. The success of a persuasive communication campaign might be measured in a change of attitude. According to previous discussions (specifically the ELM) attitudes can be changed via the central route or via the peripheral route. Assuming the management objective is to modify a behavior for the long-term, changing attitudes through the central route would be the preferred method. To this extent, ensuring optimal motivation and ability to process the information in the campaign is critical. And finally, manipulating some or all of the four communication variables might be necessary to achieve the optimal levels motivation and ability.

Is it fair to assume that all low-impact recreationists are, by definition, motivated and able to process information relevant to their recreational engagement? Probably not, otherwise we wouldn't be faced with the problem at hand--that despite the presence and availability of low-impact practices recommendations, some recreationists continue to practice negative behaviors (behaviors contrary to low-impact recommendations). In the context of source, receiver, channel and message variables, how might each of these account for attitude consistent behavior following low-impact practices recommendations ?

As previously mentioned, research on source variables has received considerable attention, with the composite measure of source credibility leading the way. Increasing each of the three components of source credibility (expertise, trustworthiness, and attractiveness) would amplify the attention given to the source and, in turn, increase the source's persuasive potential. A point worth mentioning here, is that these manipulations of the source variable may not be at all sufficient to modify attitudes in the desired direction. For instance, if the message itself contains weak or specious arguments, a single, credible source may not be enough to change attitudes through the central route. However, if a peripheral attitude shift is

sufficient to meet management objective, then offering a simple peripheral cue, such as a credible source, might do the job.

Implications for Low Impact Behavior

A critical question pertaining to the receiver variable concerns personal relevance of the particular behavior. For instance, is following low-impact practices recommendations of low or high personal relevance? When coupled with our previous example of a source variable, and a variable of argument quality, we uncover another layer of complexity. The findings of Petty et al. (1981) suggest that when personal relevance is low, then source expertise can influence attitudes more than argument quality, and conversely if personal relevance is high, source expertise has no affect on attitudes while argument quality is a determining factor. Thus, if the personal relevance to follow low-impact practices recommendations is low, then source expertise might be more effective than the quality of the argument. And if personal relevance to follow low-impact practices recommendations is high, then the reverse might be true.

Manipulations of channel variables have yielded mixed results, when comparing different channels. In fact, Petty and Cacioppo (1981) noted that the success or effectiveness of any channel tends to be situational depending on any number of source variables. However, one consistent finding has shown that face-to-face contact is highly effective (Katz & Lazarsfeld, 1955). However, is it economically feasible to employ this technique for relating low-impact practices recommendations? Perhaps it is if recreationists need to obtain a backcountry permit prior to engaging in some activity. In reference to a specific recreation scenario, Oliver, Roggenbuck and Watson (1985) found that face-to-face communication resulted in a greater decrease of two types of depreciative behaviors than occurred following a written communication.

Finally, specific recommendations for message variables would likely center on the strength and quality of the argument. Additionally, Knopf and Dustin (1992) list a number of variables relating to the overall understandability of the message: level of comprehensibility, message organization, coherency, and clear reasoning. In short, persuasion is more likely to occur when the message is easy to understand. Once again though, manipulations in the message variable should not be viewed in a vacuum. The overall strength or weakness of the argument can be pushed aside in favor of another variable such as the involvement of the receiver and/or the credibility of the source.

In conclusion, the research on communication variables are very closely related to components we've discussed in relation to the ELM. Source, channel and message variables can be manipulated to increase the motivation and ability of the receiver to process information. Increasing motivation and ability steers the receiver towards the central route to persuasion, which can produce attitudes that are relatively enduring, resistant to change and predictive of behavior. If recreationists are currently receiving information on low-impact behaviors from one source, through one type of channel, and in the same message format, then perhaps new ways of conveying this information should be examined. Further, perhaps a definitive profile (receiver variables) of those recreationists who are not following low-impact practices recommendations should be developed so that we might create more appropriate information campaigns.

D. Summary of Current Approaches

From the initial work on the attitude-behavior relationship by Fishbein and Ajzen and their Theory of Reasoned Action and Theory of Planned Behavior, to Petty and Cacioppo's Elaboration Likelihood Model and research on communication variables, attitudes remain at the core of research in all of these areas. Whether or not we're discussing the basic relationship between attitudes and ultimate behavior or how accessible or strong attitudes are, the focus of this chapter has been to illustrate how past attitude-based research might be used to further our understanding of the problem of noncompliance with low-impact recommendations.

Throughout each of the previous four sections, we have considered attitudes as a malleable yet critical component of the overall behavior process. Fishbein and Ajzen proposed the three different stimuli and responses (cognitive, affective, and behavioral) that are linked by attitudes. And making use of each of these three stimuli might lead to a more consistent practice of following low-impact recommendations. The interplay between attitudes and subjective norms was developed in the theory of reasoned action and this interplay was expanded to include perceived behavioral control in the theory of planned behavior. Petty and Cacioppo illustrated the varying degrees of attitude endurance, resistance, and predictability as they develop through the central and peripheral routes. Finally, a number of studies on communication variables were discussed that showed how manipulations in these variables can modify attitudes.

Up to this point, we've begun our discussion under the umbrella of knowledge that attitudes are created or modified as a result of some type of informative stimulus. While, this

assumption is correct, we haven't yet acknowledged the importance or the diversity of the general topic of information. It is this topic of information that we will address in its expanded role in the following chapter dealing with cognitive structures and decision-making processes.

COGNITIVE STRUCTURES

A. Introduction

Cognitive structures are facets of memory or other cognitive processes that help an individual cope with the world in which they live. These mental representations provide generalizations that allow people to appropriately perceive and understand the social and environmental context. Cognitive structures help guide behavior through the organization and processing of information and as such can dictate or bias a pattern of decision-making and action. Cognitive structures range from categorization of objects and events into associative networks that allow for generic properties to be attached to the specific situations, to heuristic rules that govern how decisions are made.

Cognitive structures are an essential element of coping with the events, situations, and decisions that confront us in the social and environmental world. The information and experience upon which these mental processes are constructed informs all behavior. Decisions and actions would be impossible without the accumulation of information that an individual has gained from direct experience or through social learning. Cognitive structures help us recognize the context for behavior and the possibilities for action presented by that context. They can also help the individual understand or realize the expectations that are implicated in the particular situation. For example, cues for behavior may be present in the environment and cognitive structures allow the individual actor recognize, interpret, and follow those cues. National Park managers might, for instance, construct boardwalks that encourage visitors to follow a certain path through a fragile ecosystem. Not only must the visitor recognize that a collection of wooden planks nailed together are a deliberate construction for accommodating visitors, but that a certain behavior is expected of them. They might have learned these associations of planks of wood with behavior from watching other visitors or from family and friends.

Humans are cognitive misers in that they have limited cognitive capacity and limited time and ability to perceive, interpret, and process all the information that an environment presents to them. Instead, the need to make decisions quickly and efficiently allows us to

take action and cope with the environment. The alternative is to be endlessly mired in information processing and decision making, never able to apply those decisions to the requirements of living. Cognitive structures, particularly associative networks such as schemas or stereotypes, help individuals infer meaning for a specific object or situation from familiar or similar associates. As a result we do not need to be absolutely sure of all the specific requirements of the present event, but rather can extrapolate with reasonable and appropriate confidence from past experience or learned patterns. Cognitively, we have categories so that we do not have to remember every single object and event. Cognitive structures are an attempt to balance economy, informativeness, and natural coherence – a balance between the specific information of the event or object and the generic information of the category of events and objects.

Numerous approaches to cognitive structures have been put forward and empirically documented. What all these have in common is their ability to affect the memory and judgment phases of any decision to act. These are influences that may or may not be obvious to the individual, but they provide a pattern of response that could be predictable. They also provide an opportunity for manipulation or management in that these patterns are recognizable and socially constructed. For example, Graeser and Clark (1985) demonstrate the use of verbal protocols or thinkalouds to document the cognitive structures and heuristics that are used by people as they make sense of their world. These structures of knowledge were seen to be taxonomic or categorical features of memory that were related to the individual's goal-oriented behavior.

B. Perception

Description of the Concept

Cognitive structures not only influence the information retrieved from memory or provide a favored judgment process, but also influence the information that is perceived from the social and environmental context. As Neisser (1972) has suggested, sensory input is not just passively received and then recognized, but is actively constructed or sought out in the context. Leff, Gordon and Ferguson (1974) describe cognitive structures (they call them cognitive sets) that "select specific types of data for processing" (p. 396). These structures operate by giving priority to certain phenomenon or their particular identifying features, and also on the "significance, interpretation and emotional overtones of one's experienced surroundings" (p. 396).

When people attend to a stimulus in the location or situation, they often attend to it selectively, filtering the information that is seen and given attention. As Wyer and Carlston (1979) describe, people interpret features of the social or environmental context in terms of previously acquired or constructed concepts and knowledge. That is, attention to and recognition of a situation requiring a response or choice is biased by previous experience and the cognitive structures constructed from that previous experience. This is one explanation of the discrepancy observed between the decisions people make and the information they suggest to be underlying the decision (Lichenstein & Srull, 1987). The cognitive structures may not be obviously influential to the decision maker or aware of the selectiveness of their perception. However, the more the decision making process is broken down into its individual parts, the more accurate is the report of the cognitive processes involved. Getting individuals to report processes as they occur can remove the tendency to attribute cause to particularly recognizable processes and helps to document subconscious or processes that the individual may not be aware of relying upon.

C. Defining attributes.

Description of the Concept

Traditional theories suggest we generalize from an individual object by noting the similarities and ruling out differences. Thus a defining attribute is identified, some property, semantic marker, or feature of the specific situation that is necessary and jointly sufficient to trigger the categorically-based generalizations. This assumes, however, that all noticeable attributes are important in defining generalizations and that any member of a category is able to trigger the generalization. As Glass & Holyoak (1973) explain not all properties, features or semantic markers are necessary or jointly sufficient. Some attributes are more important than others and some members of the class are more typical or noteworthy than others. These cues may provide important opportunities for manipulation or coercion of behavior.

Wittgenstein (1958) persuasively argued that some, if not all, semantic concepts are impossible to define or clearly differentiate in any logically sustainable manner. That is, some valid and useful concepts imply do not have defining attributes. However, socially and cognitively, there is still a core of understanding as to what the concept represents. Each individual builds their own cognitive memory of what that category or phenomena is, and what features are most useful for triggering the information stored in memory concerning the category of phenomena. Thus, while cognitive structures are not necessarily a given in the

natural order of things, they are rather individually and socially constructed. Similarly, these cognitive structures may not be physically or consistently present in memory, but they are persistent features that are validated and operationalized in human behavior. They are powerful determinants of behavior because they are useful and necessary in an increasingly complex world.

Implications for Low Impact Behavior

Generally, visitors are not trained or given any guidance on when to look for situations that require low impact practices. That is, they receive less information on *how* to interpret whether a particular context might require low impact behavior and more emphasis on what that behavior might be. However, how people perceive and interpret environmental contexts may be an avenue for future low-impact practice education efforts. Recognizing the possible impacts of their behavioral choices first needs the visitor to open consider that there are choices to be made. This presumes recognition of the potential locations for their behaviors. For example, in order to choose a low-impact location to camp, the visitor must recognize more of the potential locations than just the single most obvious location. (This would be true even if the most obvious location is the least impactful location). Education efforts might then center not just on selecting the right place but recognizing the desired characteristics of a campsite (flat, close to water, scenic), also on the recognition of potential low-impact locations. Some wilderness management situation this might include where no-one else has camped before, but in other situations it may be where clearly other visitors have consistently and regularly camped before. The educational efforts need to more clearly instruct people where to camp, what particular identifying features should be used to recognize potential campsites and what criteria should be focused on in making the choice of where to camp.

In this way, more assistance is being offered to the visitor in choosing low-impact behaviors. Instead of managers expecting the visitor to be able to carry out low-impact behaviors, even when the visitor knows what to do, managers can help educate the visitor on the potential contexts in which that low-impact behavior is potentially appropriate. This will vary from region to region and guidelines such as camping on barerock in the Southwest (a resistant site), on bare mineral soil in the Rockies (a highly impacted site), and on sand or gravel bars in coastal and river settings (above daily high-tide levels but below monthly high-tide lines) are context specific guidelines that reflect more generic principles. These are

examples of providing context specific, yet straightforward, cues of what to look for and recognize in potential campsites.

As will be discussed in more detail in the next section, it is not possible for the visitor to perceive and collect all the information relevant to a low impact behavior decision. Instead, there are some contextual attributes and some situations that are more worthy of attention and consideration. However, managers should not assume the same terminology and labels are understandable by visitors. If a different word or concept is used by managers than is in common use by visitors, then it is unlikely to be useful or effective cues or prompts for the visitor. Instead it is likely to trigger other, perhaps unwanted associations. Bureaucratic or overly technical terminology is not only difficult to clearly understand but also possibly associated with notions of control, coercion, or penalty. These notions may be counterproductive to the objective of facilitating low impact behavior.

D. Relational Structures

Description of the Concept

Generally, as people perceive and interpret any particular situation they rely upon previously constructed cognitive structures to help them make sense of it. People recognize the objects that go along with the context, and particular meaning and behavior options that are associated with those objects. The meanings and actions are easier to comprehend and apply if they naturally go along with the object and vice versa. In the process the individual's role or expectations of a role can become clear, which also constrains action.

These associative networks represent the interrelationships between concepts and objects. According to Wyer and Carlston (1979), the association in memory is built upon the frequency with which the concepts are thought about or experienced together. Proposed as a spreading activation model, when a particular concept (or node) is directly thought about or activated, associated concepts are also directly brought to mind. Thus, the more frequently a concept has been used or brought to mind in the past in a particular context, the more likely it is to be relied upon or influential in future decisions.

Given that humans seek economies and useful shortcuts, the associative networks provide a semi-automatic approach to interpreting a situation, perceiving what useful information is available in the situation, and therefore determining what memory components should be recalled or how the judgment and decision making processes are going to be framed. Similarly, the manner in which the concept is remembered will influences the kinds of

representations formed of new applications or contexts of the concept. Thus, according to Carlston (1992), passive observation will create memories most dominated by sensory observations such as appearance, while behavioral and emotional interaction will trigger affective relationships and categorizations of behavior.

Perhaps the best known cognitive structure or associative network is that of schemas. These are organizing structures of memory and knowledge that allow people to comprehend complex situations without the need to analyze all aspects of the situation. Schemas allow the individual to fill in the aspects of an event that are not immediately explicit. Marcus & Zajonc (1985) suggest that people are very selective in what they notice and remember in any particular situation. They found that the perceiver does not "attend to all the available information and was not particularly adept at evaluating, in an important manner, the independent contributions of persons, situations, and entities to the observed effect" (p. 142). However, observers are often quite systematic in their selectivity and this is reflective of the underlying cognitive schema that has been activated. As Neisser (1976) suggests, "information can be picked up only if there is a developing format ready to accept it. Information that does not fit such a format goes unused. Perception is inherently selective" (p. 55). An object, for instance, that fits the activated schema is more likely to be paid attention to than something that did not fit the schema. Neisser (1976) summarizes by saying, "perceivers pick up only what we have schemas for and willy-nilly ignore the rest" (p. 80).

Schema allow the observer to quickly process and personally manage or cope with a complex social or environmental situation. Schemas allow the observer to quickly identify relevant information, group them into manageable units and categories of knowledge, and to identify a cognitive and behavioral strategy for obtaining further information that is necessary to solve the problems or reach the goals commonly associated with those sorts of situations (Singer & Kolligan, 1987). The resultant information processing is, thus, theory driven and not automatically prescribed by the social and environmental context. However, it should be noted that the schema both reflect the logical and social relevance of the knowledge and objects involved, but also their degree of past occurrence. Schema are supposed to be more generic and often persist in the face of evidence to their contrary (Turk & Salovey, 1985). That is, once constructed in memory, schema are relatively resilient in the face of new or contradictory situations. They would lose their efficiency value if they needed updating for every new situation encountered.

Note that schema develop with experience, thus highlighting the importance that initial experiences can play in subsequent behavior. It is only through learning that we

become able to "perceive progressively more subtle aspects of the environment" (Neisser, 1976, p. 62). The act of perceiving doesn't change the environment, but it can and does chance perception of the environment. Some schema are idiosyncratic, while others are widely communicated and shared though out a community (Trafimow & Wyer, 1993). Schemas of past events allow their meaning and importance to be stored and remembered in detail, and thus efficiently shared with others as they prepare to, or actually, experience similar events.

The influence of schemas on most aspects of decision making should be observable (Marcus & Zajonc, 1985). Schemas influence each of the four stages of decision making : identification of the need for a decision, retrieval from memory of information needed for a decision; use of judgment or rules for decision making; and appropriate communication or action of the decision. Schema will influence both conscious and preconscious cognitive processing and operate through differential speeds, confidence and accuracy of processing. Schema, like many cognitive heuristics, are most powerful when they extend beyond the information immediately obvious in a situation. Schemas are useful in cases of the relatively unknown or unspecified where the schema can fill in for information that is otherwise not recognized or familiar in the environment.

Schema are particularly influential in judgment and expression phases of decision making (Wyer, 1974). For example, the expectation that campsites are necessarily associated with a wilderness destination strongly colors the decision of whether camping in a particular location is appropriate. If the location looks like a campsite, and therefore is associated with wilderness camping, then camping is assumed by association to be appropriate. If the individual's schema does not necessarily include consideration of the environmental impact of the camping behavior, then that information may not enter into the judgment phase of the decision to camp in this location.

Wyer & Srull (1989) have proposed an extension of a schema approach that elucidates how the information is stored and retrieved under different cognitive demands. They envisage three spaces in memory, each thought of as a set of storage bins: 1) a semantic bin, whereby it is the literal, context-free, definitions that are most active; 2) a goal bin, where schemas that are associated with different behavioral or cognitive processing goals are stored, and 3) referent bins, each of which holds strands of information considered associated with a specific referent, domain or context. Knowledge representations are added to the bins in roughly the order they are made. And so, when a subsequent judgment task is required, those

judgments will happen consistent with the relevant bin and its most recent contents. Memories, in effect, are reconstructed to make them consistent with judgments.

Furthermore, if decision makers cannot find a representative schema whose central concept has direct bearing on the judgment, then they will base the judgments on an evaluative or descriptive element (Wyer & Carlston, 1979). Thus, again, memory and judgment can be relatively independent. That is, memory of what is a 'good' decision may not be accessible to subsequent judgments if other, more potent schemas are triggered by evaluative or affective dimensions.

Part of many schema or categorizations of objects and events is a sense of what is typically associated with the group. These prototypes may or may not represent an individual object or event, but may also be constructed from an amalgam of prototypical features. Prototypes consist of "relatively stable, abstract representations of a large set of more or less associated attributes, trait characteristics, characteristics behaviors" and the situations typically associated with that person, object or event (Turk & Salovey, 1985, p. 8). Some features of the prototype are more typical of the category than others, and the boundaries of the concept that the prototype represents are somewhat fuzzy and unclear. People may not agree on the boundaries but the best example of the category is often clear and commonly accepted (Estes, 1994).

The prototype is highly representative, an easy match to the category of the schema and therefore the closer the match that an individual situation may be, the more efficient the categorization of triggering of the associative network. Prototypes allow people to distinguish individuals as members of a group from among the mass of individuals. Like schemas, they allow people to perceive and act upon local information as well as a more generic pool of data. The difference between a prototype and a schema is that the prototype has very specific expectations. Schemas help fill in or sensitize the individual to the gaps of information based on an organized set of relationships. Whereas the events and occurrences that define a prototype are, by definition, highly likely to occur and therefore triggering the prototype can yield very little new information. For example, some events are so predictable that it is part of the definition of the event and information about the prototype is therefore part of the definition of the event. The prototype, therefore, yields few new insights. Other situations are so unusual that, again, little information is gained from memory of other events.

In comparing two objects, one real against the prototype, the similarity is judged more on the basis of common features than on distinctive or discriminatory features (Tversky, 1977). As a result, when people are looking for similarity they often see common features and

overlook distinguishing features. Furthermore, according to the selective copy hypothesis (Trafimow & Wyer, 1993), in building a cognitive representation of an event or situation (a necessary step in the understanding of the event prior to decision making and action) schemas are triggered and incorporated only if those schemas also help locate schema-related events. That is, seemingly unrelated events are equally influential in the construction of an event's structure in memory.

Stereotypes are a particularly powerful form in that stereotypical attributes are automatically associated with an individual once the stereotype is triggered by easily observable characteristics such as skin color, gender, accent, dress, etc. This activation is often unintentional but efficient for widely shared stereotypes that match the social and environmental context. However, stereotypes prime people to selectively notice confirming attributes, thus shaping the interpretation of situations. This is further exacerbated, then, in that which characteristic becomes salient depends on how noticeable the characteristics is within the context. Stereotypes are often active in extrapolating extreme behaviors beyond their range of occurrence. That is, because negative characteristics, for example, are more memorable, people tend to assign these traits to the cognitive identification of groups of people, assuming the negative characteristics adequately represent stereotypical dispositions (Hamilton, 1979).

For example, the most noticeable characteristic of a backcountry campsite, say the amount of bare ground, becomes the dominant cue to appropriate behavior in that location. This could be problematic in situations in which percentage of bare ground is a poor indicator of appropriate behavior. However, bare ground, like the amount of litter, are easily noticed by untrained observers and represent assumed relationships with frequency or degree of impact. The stereotypes associated with those levels of assumed impact are likely to be resilient stereotypes that would resist contradictory characteristics or instructions. The ability of visitors to accurately identify true indicators of impact status and avoid perhaps inaccurate correlations with easily observable or memorable characteristics must be questioned.

The ability of visitors to correctly label or categorize stimuli is also questioned. That is, there may be situations where visitors are prompted or stimulated to respond by incorrectly trigger an associated schema or stereotype. Shacter & Singer (1962) described the process of cognitive labeling whereby subjects who were physiologically provoked then proceeded to incorrectly label the source of that arousal. Schacter & Singer described how the cognitive process of correctly identifying and responding to stimuli is easily manipulated, as well as easily short-circuited by needs for cognitive efficiency or otherwise constrained cognitive

resources. Zillman, Katcher and Milavsky (1972) further demonstrated the ability of people to change their judgments as a result of physical exercise / arousal. As Jones (1990) describes, "if people for any reason misperceive the circumstances of physiological arousal, their emotions will fit their misperceptions rather than the true state of affairs" (p. 210). This is doubly problematic in that mood and emotion are powerful activators themselves of memories. Thus, not only will incorrectly triggered emotions shape judgment but also the recollection of applicable knowledge.

As described elsewhere in this report, one approach to self identity is that of the dramaturgical self. This is a conceptual structure that suggest the roles, scripts, orders and results of stereotypic events. Often these are associated with a specific context and, as such, provides a short cut to actions and a presumed temporal sequence of events (Schank & Abelson, 1977). Thus, the scripts that can be triggered by context provides a network of information and expectations associated with the stereotype of the context. Just as with a drama script, there is then expectation that events and behaviors will unfold with a particular order and organization. Reactions of the human actor are also predicated by the stereotypical script, as are goals and outcomes (Mandler, 1984).

One particular form of cognitive structure related to recreation locations is that of cognitive maps. These are mental models of the spatial relationships of objects in the external environment (Kaplan, 1978). Cognitive maps thereby allow an individual to keep everything organized in their mind and still keep track of the whole (Knopf, 1981). They provide a road map to mentally 'see' what is beyond our immediate perception. These maps are not so much accurate in literal geometric distance, but are more topological or relational (Moar & Bower, 1983). Given this distortion, it is not surprising to learn that people have a pronounced tendency to introduce elements into their cognitive maps that aren't really in the scene (Tversky, 1981). Thus, these mental images may introduce expected human behaviors into specific geographic situations. This selective cognitive processing is believed by some to be central to human decision making and behavior (Kim, Mutter & Westphal, 1988). Visitor behavior would therefore be partially determined by the structure of the cognitive maps formed. As Knopf (1981) demonstrated for visitors to Gettysburg National Military Park, early cognitive maps formation from an interpretive display or experience pre-empts other cognitive structure construction and can enhance the power of information transfer to the visitor.

Implications for Low Impact Behavior

There is a clear opportunity for managers to build positive, habitual associations with low impact practices. The aim should be for visitors to recognize an opportunity for low impact behavior and thus to have associated motivations, justifications and specifics of application of learned behaviors. Educational campaigns, including training sessions and bulletin boards, should aim for a consistent content and form of low impact practices. In this manner, the seven principles of the Leave No Trace program provide an associative network that is widely taught and promoted. The more frequently this set of principle is encountered in relation to the environmental context the more likely they are to be adapted.

However, some control is needed over the context in which programs such as Leave No Trace are associated. For example, if these educational messages become too dispersed and not adequately anchored within wildland settings the less the likelihood of the associated network being triggered in that setting. Also, it should be noted there is guilt by association, such that corporate sponsors or settings with which the program is conducted themselves have connotations. Should the identify, motivation, or associations of the corporate sponsors or setting be perceived to run counter to the purpose and ethics of low-impact practices, then the visitor may pause to wonder if they have the right associative network for the wildland situation or context.

Since schemas tend to be persistent and a more generic system of knowledge, the importance of initial experiences is apparent. The lessons that are learned early will form the cognitive framework into which subsequent experience and knowledge will be fit. The family, peer, or educational group with which the visitor begins their outdoor experience will not only share skills, behaviors, and values but also the schema through which situations are interpreted. Educational efforts towards outdoor novices are to be encouraged, as is efforts to the influence the incorporation of up-to-date low-impact practices into school and institutional outdoor learning curriculum.

Educational efforts should focus attention at all three levels of schemas: semantic knowledge – where labels, definitions, and terms associated with low-impact behavior are consistently applied and reinforced; goals - which should include not just ethical motivations but also cognitive processing goals such as efficiency and competency should be included; and referent schemas that apply specific features of the environment to the low-impact behavior being explained.

The use of prototypes offer themselves as presently underutilized educational tactic. A prototypical low-impact campsite, for instance, would illustrate many Leave No Trace

principles and the use of visuals would allow the visitor to imagine, remember and compare an ideal campsite. Visual representation of ideals could be made with photographic, video or diorama techniques. Appropriate camping behaviors such as the use of backpacking stoves, lightweight tents, as well as location characteristics can be unambiguously displayed and remembered.

Some managers, such as those at the Boundary Waters Canoe Area Wilderness in Minnesota, have begun putting details of popular campsite on the internet. These details include prevailing wind direction, fish stocking levels in adjacent lakes and streams, and facilities (bathroom, fire grill, etc.). In doing so, managers are creating a set of characteristics by which campsite should be evaluated. Alternative characteristics such as distance from water, aerial extent of bare ground, present of campfire rings, etc. might be more appropriately emphasized since these are often more crucial cues or criterias for low-impact campsite selection. Similarly, guide books and other route recommendations (or maps, bulletin boards, signs, etc.) clearly endorse stereotypical behavior and create expectations of what the visitor can or should experience.

Chapter
4

JUDGMENT FORMATION

CHOICE RULES

Description of the Concept

Are human beings rational ? Psychologists have answered with a resounding, 'yes'. Not only are decisions made with acceptable consideration of the available information, but also with logical systems of reasoning. Often these decisions follow distinct patterns of decision making, called choice rules. Researchers have distinguished two broad categories of choice rules: Compensatory and non-compensatory rules. Compensatory rules are those where individuals are allowed to adjust and make trade-offs among attributes. Non-compensatory rules do not allow trade-offs between alternatives. Once again it is worth mentioning that a great deal of cognition research is based on consumer decision-making; the same is true for these two types of choice rules. Studies of choice rules often place individuals in situations where they are asked to choose one product from two or more based on a number of different product criteria (i.e., cost, features, functionality, etc.). We believe that many of the aforementioned low-impact criteria such as all of those associated with campsite selection should be substitutable for those product-related criteria. An additional point worth mentioning is that all choice rules serve as models only among situations where there are well-defined alternatives (e.g., Campsite A, Campsite B, Campsite C, etc.). In this respect, recreationists must be able to identify and apply the same criteria across each campsite. Similarly, a great deal of study has been given to decision-making in situations where the alternatives are not so clearly defined (Tversky & Kahneman, 1982). To begin with though, we'll examine three types of non-compensatory rules.

As previously mentioned, non-compensatory rules do not allow the individual to make trade-offs. The first of these rules, the conjunctive rule is normally considered what's

termed interdimensional. Interdimensional decisions refer to choices where a single alternative is examined based on all attributes and rejected if the alternative fails on any one of the criteria. As soon as an alternative fails on a criterion, it is discarded and the individual moves on to the next alternative for the same process. The decision process may continue until all alternatives have been evaluated or the process may stop as soon as the individual finds an alternative that satisfies all criteria. The later example illustrates a potential shortcoming in a great deal of decision-making scenarios: choosing the satisfactory alternative rather than the optimal alternative.

Specifically, the aspect of satisfactory vs. optimal choices is a topic that must be considered when examining failure to comply with low-impact recommendations. Simon (1955) discussed the general concept of making a satisfactory choice vs. an optimal one with his satisficing principle. Of critical importance to us is defining what exactly constitutes a failure to comply. On the one hand, failure to comply might be defined as a gross disregard for a number or all of the low-impact recommendations. On the other hand an individual might incorrectly identify the stimulus for a single criterion. Would both examples be defined as a failure to comply? In the later case, might this be seen as an instance of selecting a satisfactory alternative rather than the optimal alternative.

Another rule in the non-compensatory category is the lexicographic rule. In contrast to the conjunctive rule, the lexicographic rule assumes that all alternatives are first compared with respect to the most important attribute. If one alternative has a higher value on the most important attribute than the others, then that alternative is chosen, regardless of the values the alternatives have on other attributes. If all alternatives are equal on the most important attribute, then the decision process is repeated for the next most important attribute. This then is considered an intra-dimensional form of processing. With the lexicographic rule, it may be easier for an individual to make the optimal choice rather than a merely satisfactory one. This is because attributes are first prioritized and then each alternative is evaluated based on the prioritized list of attributes. It is assumed that less than optimal choices will be eliminated through the evaluation process, however this only holds true if the attributes are correctly prioritized and all critical attributes are considered.

Compensatory rules do allow trade-offs between alternatives, where relative attractiveness of some attributes can be traded-off against other attributes. This is generally considered a very quick and unsophisticated comparison of ordinal attractiveness. Abelson and Levi (1985) illustrate how this process might be used when deciding on the purchase of a car. For instance, the low price is more attractive than the safety rating for the vehicle. Some

sophisticated trade-offs do occur, however this can rapidly become cognitively cumbersome (e.g., for each additional mpg I am willing to spend an additionally $100 on the price of the car).

It is generally assumed that individuals do not limit themselves to just one of the choice rules discussed above, but rather they rely on a number or all of those discussed in addition to several others not discussed here. Determining which choice rule that will be employed can be quite complicated. However, research has identified two general areas that offer some explanatory power for choice rules: task complexity and information format (Abelson & Levi, 1985).

Viewing human cognition in the vein of an information processing model illustrates how the complexity of the task can compromise the quality of the decision. Because individuals are limited in their information processing capacity, they will tend to simplify the cognitive requirements of the decision process. One of the most critical components of task complexity is information load. Information load has typically been defined as *m* (the number of alternatives) times *n* (the number of attributes), or $m \times n$. When choosing between just two alternatives, individuals usually employ a compensatory choice rule that allows relatively simple comparisons between all alternatives and attributes (Payne 1976). However, Abelson and Levi (1985) noted that when individuals are faced with six or more alternatives each with several attributes, they were more likely to reduce the number of alternatives through a screening process involving one of the non-compensatory rules. When the number of alternatives was reduced sufficiently (usually to two or three alternatives) a more thorough examination of each alternative is conducted. "Information load, as defined by amount of data, thus appears to affect decision quality in two ways: First, individuals tend to use simple and less optimal rules as information load increases. Second, the reliability with which individual use choice rules tends to decrease as information load increases (Abelson & Levi, 1985 p. 263).

Time pressure is another factor that can influence decision making in the form of task complexity. It has been suggested that when time pressure is of consideration, individuals will attempt to simplify the decision by disproportionately weighting unfavorable information (Wright 1974). The conjunctive rule is well-suited in this scenario because it will quickly eliminate any alternative that is unacceptable. Additionally, Ben Zur and Breznitz (1981) suggested that an individual's primary objective in time constrained situations is to reduce the threat of future negative consequences. This is a more conservative approach to decision-making where greater emphasis is placed in negative information.

In situations where both information overload and/or time pressure are considerations, individuals tend towards a satisfactory compared to an optimal choice. We can see how each of these factors might influence campsite selection. In a number of backcountry settings or wilderness areas, individuals are free to camp wherever they choose. On the one hand, this might represent an essentially infinite number of campsite choices. Realistically, there would be most likely a fixed number of "available" sites to camp, in terms of any significant change in the composite of attributes that make up a campsite. However, we can imagine situations where the potential number of campsites (*m* number of alternatives) is so great that some are quickly eliminated from consideration using one of the non-compensatory rules. Also, we can imagine situations where selecting a campsite quickly (time pressure) is of paramount importance. Factors such as backpacker fatigue, inclement weather and/or darkness might all hasten the process of finding and choosing an appropriate campsite.

Multistage models of decision-making arose in response to knowledge that individuals often employ different choice rules depending on the complexity of the decision. Montgomery and Svenson (1976) suggested that choice rules are ordered such that simpler rules will be used before complex ones. This is often done in an effort to reduce the number of alternatives. Wright and Barbour (1977) proposed a model in which typical decision processes consist of a screening stage and more evaluative stage. However, these researchers noted that even multistage models can occasionally result in sub-optimal choices because alternatives that are eliminated early in the decision process may, on occasion, be the best choice. "Sometimes convenience is best served by using a sequence of different choice rules rather than just one rule" (Abelson & Levi, 1985 p. 264). Beach and Mitchell (1978) hypothesized that choice rule selection depends on the relative cost/benefit between the desire to make the optimal decision and the cost of investing the time and effort in the decision making process. Four conditions appear to dictate when effort is expended to make a complex evaluative decision: 1) limited or no time constraints; 2) the decision is relatively important; 3) the outcome of the decision is irreversible; and 4) the individual making the decision will be held accountable for it. When these four conditions are present, individuals tend to take the time and exert whatever cognitive effort is needed to come to an optimal decision.

The concept surrounding task complexity is what has been referred to as the cost of thinking. As previously mentioned with the multistage models, it is assumed that individuals search for the cognitive path of least resistance. With both compensatory and non-compensatory choice rules, as well as with the multistage models individuals search for the most efficient ways to make a decision while balancing at least the four contextual factors

listed above. "In general, the cost of compensatory rules increased rapidly as a joint function of number of alternatives and number of attributes, while the cost of non-compensatory rules increased only slightly or leveled off" (Abelson and Levi, 1985, p. 267).

Implications for Low Impact Behavior

Little is known of the choice rules used by visitors to select their low-impact practices. There are characteristics of typical low-impact contexts, such as a reasonably short list of choices and a relatively constrained time period in which to make a decision, that would suggest that choice rules are likely to come into play. As will be reinforced in the next section on heuristics, the opportunity therefore exists to train visitors as to appropriate criteria on which to choose between alternatives and the choice rules used to consider the trade-offs between alternatives. Training would also be useful on the clear identification of alternatives. Leave No Trace programs and the curriculum of schools and organizations, such as the National Outdoor Leadership School and the Boy Scouts, would be good places to begin developing such training.

Emphasis in Leave No Trace training should also be placed on the four conditions previously mentioned as being required for a more complex evaluative decision. These four conditions are: 1) having sufficient time for decision-making, 2) viewing the decision as important, 3) the irreversibility of the decision, and 4) the accountability of those making the decision. Each of these are worth emphasizing, such as the value of planning and advance preparation of route planning such that allows plenty of time at the end of the day to select appropriate campsites. Training programs should also clearly demonstrate the importance and impact of low-impact practices. For example, 'before' and 'after' photographs might illustrate the impact of incorrect backcountry practices, as well as the long recovery period required to rehabilitate these impacts. Programs might also wish to include details of how many outdoorsmen and women are now learning and practicing low-impact behaviors, helping to create a norm and a social accountability for the behaviors chosen. Clarifying what is an unsatisfactory behavior will help visitors know to continue their decision until a more appropriate alternative has been selected.

While it is important for trainers to emphasize the need to attend to and make good decisions concerning low-impact practices, since complexity can undermine the quality of the decision, it is worthwhile to continue to develop simple techniques of identifying cues, recognition of alternatives, and selection of criteria to be applied in a specific low-impact

situation. Consistency, clarity, and context specificity in education messages will help ensure their greater effectiveness.

HEURISTICS

Description of the Concept

In a hypothetical world humans would make rational, logical decisions with complete access to all the necessary information. However, in reality there is simply not enough time and knowledge to do so. Instead, human cognition has evolved its own decision making processes to quickly and efficiently extract the minimum necessary amount of information from the context to proceed. If this were not the case, we would be forever waiting for the last piece of information and never acting (other than to judge that not all options had been sufficiently evaluated).

As a result, many decisions follow fast, frugal decision making rules called heuristics. Instead of assuming unlimited access to information ideally available for any particular decision and unlimited cognitive ability to recognize and process all that information, heuristics and rules are shortcuts that are appropriate decision making methods to handle most tasks (Simon, 1990). The use of heuristics has been found to be as accurate and useful as other decision-making methods that make use of all available information and extensive consideration of that information (Gigerenzer & Todd, 1999). This is partially due to the fact that all information needed for a 'perfect' decision is never available, nor is there ever sufficient time to cognitively process all the options and consequences. As a result all decisions are imperfect and heuristics represent the accumulated experience of many decisions. the other apparent option for fast, frugal decision making is expert opinion which also bypasses the need for 'complete' information. However, expert opinion is often not applicable, useful or valid.

One of the best known heuristics is the availability heuristic (Tversky & Kahneman, 1973). Essentially, this rule prioritizes those events or options that are most easily brought to mind. That is, if an alternative is easily remembered, then its future applicability is likely to be high. There is some validity to the availability heuristic in that events or options that were numerous in the past are likely to be easily remembered and are also likely to reoccur in the future. Instead of having to remember and compare all events or options, the availability heuristic provides a fast shortcut to a decision.

In order to fast and frugal, heuristics need to be neither fully specific to each individual decision context (in which case they would have no portability to other contexts) nor fully applicable to every context (in which case they provide little guidance). Similarly, heuristics need to be mid-way between extreme complexity (for which there would be little cognitive economy) and absolute simplicity (which would have little contextual applicability). Instead, it is both the simplicity and adaptability that makes heuristics useful. They are not so much about precision and definitive answers as they are about probably outcomes. Heuristics represent decision models that contain only sufficient detail and complexity such that a fit and accurate decision can be made. More information and parameters to the decision may not improve the decision, since the new data can overwhelm the decision. In this situation where there is too much information to be processed the decision maker must spend processing capacity choosing which data to attend to. That is, cognitive resources are used to search for and consider possible decision options from among all the presented information. There is a cognitive cost to this process that may interfere or limit the ability to make optimal decisions. As Gigerenzer & Todd (1999) suggest, "there is a point where too much information and too much information processing can hurt. Cognition is the art of focusing on the relevant and deliberately ignoring the rest" (p. 21).

Heuristics are sometimes negatively viewed as biases or unreliable short cuts. However, it should be considered that heuristics aim to fit the context in which the decision is made. Gigerenzer & Todd define this as ecological rationality, where the heuristic is "adapted to the structure of information in the environment" (p. vii). Heuristics may be psychological adaptations that have evolved for specific contexts. Which heuristic is used for any particular decision depends on the structure of the information presented in the environment.

There are three recognized sets of heuristics, representing three stages of decision making: searching for possible decision alternatives; stopping the search for options; and making the decision between options. The first set of heuristics focuses on directing the search among available information for possible options. This may be a random process, one based on a pre-conceived notion of usefulness, or based on what worked in the past. The information and options are not, however, presented all at once. Instead, some present themselves at random points of time, while other options are only viable for short points in time (that is, there is a cost for continuing to consider other options), while others become apparent only after others have been discarded from consideration.

The second set of heuristics center around the decision of when to stop the search through information and make a decision. This decision can itself be overtaxing and may

reflect an inappropriate level of aspiration. That is, a less than comprehensive review may be more appropriate than grappling with spiraling levels of incommensurability among the different information and options being considered at once. For instance, a mental play through of the options may generate a satisfactory sense of readiness to go forward with a decision. These stopping heuristics are probably the least well understood, partially due to the lack of their consideration in much experimental research (Gigerenzer & Todd, 1999). One satisficing rule is known as Try a Dozen, which quite arbitrarily stops the search for options when twelve have been identified.

Another example is the Take the Best heuristic which tries cues or criteria in order until one particular cue is discriminating, at which point the best option is selected. Take the Best is a simple stopping rule that saves on cognitive processing and can be within a few percentage points of accuracy compared with complex Bayesian probability models (Czerlinksi, Gigerenzer & Goldstein, 1999). For example, to determine which of a number of professors has the highest salary you might start by considering their rank In many cases, Full Professor could be easily selected from among the Associate & Assistant Professor. However, if there is no discrimination on rank (i.e. everyone has the same rank), then the next cue might be the region in which the home university of each professor is located. Those in the Northeast might be considered the best paid. Failing discrimination with all professors being from the same region and having the same rank, a third criteria (perhaps gender or age) might be applied. Criteria are taken in the order of their applicability in the past.

The third step is perhaps the best documented set of heuristics, those that represent the principles used for decision making. Tversky & Kahnemann (1974), for instance, described three of the best known heuristics: the representativeness heuristic, where what is most typical and best represented is considered best; the availability heuristics (described above0; and the heuristics of anchoring and adjustment, in which what comes first in time and history is used as the standard against which all other options are considered. How that comparison is made can itself follow a rule or heuristic. For example, Tversky (1972) describes elimination by aspects, a model of choice that repeatedly eliminates options from consideration stopping only when a unique decision has been made. Each cue or criteria will eliminate some of the options and used in the order of past usefulness. Berretty, Todd and Blythe (1997) has shown this to be a fast and frugal approach for categorizing events.

It should be noted that heuristics are an example of ignorance-based decision making in which more knowledge may not lead to better decisions. For example, when a fast and frugal decision must be made. The recognition heuristic is commonly applied and it requires a

beneficial lack of information to work (Goldstein & Gigerenzer, 1999). Humans have a vast and remarkable ability to recognize objects and situations. The recognition heuristic calls for an object or decision alternative to be chosen based on our recognition of the option. The logic follows that if an option is known and recognized it must have importance to use or be better performing or of greater value. Note that no recall beyond recognition is required, but that the heuristic mirrors the intricate and complex perceptual and memory processes. A separate cognitive strategy is unnecessary since the fast and simple algorithm models those of higher order cognitive learning.

Implications for Low Impact Behavior

Many low-impact behavior situations could be described as quick decision situations where there is a need for fast, frugal heuristics. Visitors often do not have the motivation or luxury for laborious decisions. The weather or tiredness often bring people to make satisfactory decisions without the necessity of considering all possible options and available information. For example, as a group approaches a lake basin in the Rocky Mountains, the first available campsite may be chosen without consideration of other possible campsites if it meets minimal criteria such as flat space for tents and access to water. Given that the group may be tired or bad weather is forcing a campsite decision sooner rather than later, consideration may not be given to criteria such as the intensity and type of recreation use in the area, the fragility of vegetation and soil, the likelihood of disturbance of wildlife and other low-impact considerations. The low-impact behavior criteria may not be perceived to have been as useful nor applicable in previous decision contexts. If the first campsite looks like a typical or representative campsite, then the fast and frugal decision will be to select it unless there is some immediately apparent reason not to. Managers should take this into account in planning trail and campsite location. The most obvious and first encountered campsite will likely remain heavily used, unless it is clearly being rehabilitated and alternatives are freely available and highlighted. A similar principle should follow trail location in relation to encouraging low-impact behaviors on trails: any less-than-ideal trail options must be clearly closed and unavailable while other alternatives are made attractive and easily accessible. Simply expecting visitors to 'do-the-right-thing" is not enough, it has to be made the best and most easily chosen option.

Educational campaigns to encourage low-impact behavior should consider a focus on the criteria used to select appropriate behaviors. Not only should there be a focus on criteria that can be used in specific contexts, but efforts should be made to link those criteria to their

usefulness and typicalness. Visual references should be used as much as possible to illustrate a 'real world' setting to which alternatives can be compared. These visual references will become reference points and help establish stereotypical contexts and behaviors. Any guidelines for low impact behaviors should be quick and easy to follow, and the behavioral options clearly recognized as such. The need to make a conscious and deliberate choice for low-impact behaviors should be emphasized.

ETHICS

A. Introduction

The practice of low impact behaviors in recreational settings can be seen in part as an expression of human values relating to natural environments. Behaviors encompassed within the rubric of low impact camping can be understood within the context of pro-environmental behaviors. Motivations to engage in pro-environmental behaviors are influenced by the values and ethical positions an individual holds. Thus, an examination of the values that recreationists hold may yield clues to the types of behaviors they are likely to exhibit in specific situations.

Ethics are considered the overriding theory of human behavior and often guide other decision-making principles (Williams, 1985). As managers attempt to fulfill the challenging mandates of resource protection and visitor use, it has become necessary to initiate rules concerning visitor behavior. Low impact behavior guidelines have served as a major source of manager initiated guidelines for behavior in recreational settings. The motivation for establishing these guidelines is largely associated with resource protection. Thus, many of the appeals for visitor adoption of low impact behavior have, at their core, a reliance upon pro-environmental values. Site selection, party size, waste disposal, and the like, are offered as ways to maintain environmental health and to sustain wilderness values. Given this underlying reliance on human values for low impact behavior, it is important to examine the role that values and ethics play in pro-environmental appeal.

Different models of ethical decision-making exist, such as an ethic of justice and an ethic of care. For instance, managers who encounter resistance to certain actions may fall victim to appealing to principles of justice when principles of care are more appropriate. Carol Gilligan (1982) contrasts these in great detail.

An individual might act according to an ethic of justice if he or she is concerned with equal treatment. An ethic of care promotes equal consideration rather than equal treatment.

The distinction between these two can be illustrated with an often-cited ethical dilemma involving two injured people. In this case a doctor roaming through the rubble of an aftermath of an earthquake, comes across two injured people. Each person has a leg injury. While one person has a relatively superficial laceration requiring several stitches, the other person suffers from a compound fracture of the femur. The doctor only has two doses of morphine left and he must deal with both injured people. Under equal treatment, each person would receive one dose of morphine regardless of their relative levels of pain. Under equal consideration, the needs of each injured person would be considered against the needs of the other and the amount of relief available. In this instance, the person with the compound fracture would get both doses of morphine, because his/her pain is more severe and two doses will do more for this person than one will do for each of them.

This distinction is also evident in a campsite selection example. An ethic of justice would promote the position that all campsites should be treated equally regardless of amount of use or environmental condition. Conversely, an ethic of care would promote equal consideration rather than equal treatment. Equal consideration is contextual where the particular characteristics of each campsite would be considered. Campsite selection using an ethic of care would lead the individual to consider the relative merits and impacts of each campsite and act in the best interest of all the campsites.

Ethics are not descriptive, they are prescriptive. That is to say, ethics do not tell us the way the world is—they tell us the way the world ought to be. The difference between "is" and "ought" plays a critical role in many cases where the natural world intersects with policy. It is clear the way the natural world is, but it is not always clear how we ought to behave with respect to the natural world. low-impact recommendations, themselves, represent a certain type of environmental ethic, and these recommendations may be rooted in an ethic of justice or ethic of care depending on the individual. Despite the fact that we may use our ethics to determine what we think we ought to do, what we think we ought to do may not always be consistent with low-impact recommendations. Thus, it may be an ethic that produces an inappropriate behavior. Specifically, if the ethic one intends to follow is rooted in equal treatment rather than equal consideration some areas may suffer needless resource damage.

Numerous authors (Driver, Dulstin, Baltic, Elsner and Peterson, 1996) have called for a greater understanding of a more inclusive set of land management ethics. Peterson (1996), for example, suggests a "human value framework is needed to achieve ecosystems management" (p. 25). List and Brown (1996) emphasize the need for managers to hear and understand a broader array of ethics and values. Managers "need to understand how different

kinds of citizens define and relate to the public lands. Resource management [today] must become profoundly pluralistic and must reflect the many relevant voices in this country" (p. 460). We suggest that a greater understanding of the ethical relationships that the public has towards their National Forests will help managers see and appreciate the depth and diversity of conviction that the public has towards these resources, and their follow-on commitment to low-impact practices.

B. Ethical Frameworks

Description of the Concept

Ethical frameworks represent both the particular and universal principles that people rely on to determine praiseworthy or blameworthy behavior. Briefly we will contrast what has come to be known as ethics of care with an amalgam of western ethics referred to as ethics of justice. In this study, the ethic of care for specific areas can be seen as guiding one or more environmental philosophies. There are a wide range of environmental philosophies, including the movements of animal rights, deep ecology, ecofeminism, and social ecology to name a few. The care ethic has found a home in ecofeminism, but we contend it holds explanatory power across a variety of environmental situations. Further it has been argued that "the scope of environmental philosophy reaches beyond ethical issues and includes diverse metaphysical, epistemological, cultural and political issues as well" (Zimmerman, Callicott, Sessions, Warren and Clark, 1998, p. 3). To wit, an environmental care ethic may help us better understand natural values and how we prioritize these values. We can care about any number of people and things and to varying degrees (Gilligan, 1982). These, then, could serve as possible indicators of their underlying environmental philosophy and act as a contributing factor in their motivations to carry out low-impact practices.

Of particular concern is how and when ethics of justice and care help to dictate certain expressions of support. For instance, if someone's environmental philosophy is more rooted in preserving biodiversity, does he/she care more for large, contiguous areas rather than urban islands of green? Conversely, if someone's environmental philosophy seems to be primarily centered on human recreational benefits of natural areas, might he/she devote time and effort towards preserving only locally accessible open spaces? Is someone's low-impact practices different in different areas depending on their ethical relationship with the area ? Underlying each of these examples are the ethics tying person to place and/or places.

Contrasting an ethic of care with an ethics of justice (see Kohlberg 1971) allows distinctions to be drawn between the particular versus the universal, the situated versus the abstract, and the contingent versus the necessary to name just three. Kohlberg (1971) developed a framework rooted in an ethic of rights wherein we would argue that people and possibly certain other things possess rights and we have responsibilities and obligations to them. Table 2 outlines Kohlberg's Six Stages of Morality.

Table 2: Six stages of Kolberg's model of moral development (Kohlberg (1971).

Stage	Principle Concern
Preconventional # 1	1. Fear of Punishment
Preconventional # 2	2. Maximizing pleasure/minimizing pain
Conventional # 1	3. What significant others think
Conventional # 2	4. What society thinks
Postconventional # 1	5. Justice and Fairness
Postconventional # 2	6. Self-respect.

Conversely, an ethic of care entails no obligations, as such, other than to do no harm and the simple fact that we care for and/or about someone or something guides appropriate behavior. Because the care ethic espouses no specific behavioral guidance individuals are free to carry out their expressions of support without regard to classifying these expressions in abstract, universal terms. Expressions of support that are tied to ethics of justice would find their justification in generalizations. This distinction is important when attempting to understand how and when people say they care for some particular natural area.

The contrast in ethical frameworks was first identified by Carol Gilligan (1982) in her book, *A Different Voice*. Developed as a feminist response to Lawrence Kohlberg's Six Stages of Moral Development, the ethic of care as described by Gilligan attempts to reincorporate the particular and situatedness into the ethical domain that was lacking in traditional western ethics, particularly those of Kant, Mill and Rawls. The fundamental moral unit of concern here is the relationship; contrast this to other ethics that prioritize the individual or individual rights. Each of these ethical perspectives will be discussed in turn.

Ethics of Care and Justice

Even a concept so common as care is subject to multiple interpretations. Blustein (1991) identified at least four different interpretations of the concept of care: 1) to care for; 2) to have care of; 3) to care about; and 4) to care that. *To care for* embodies "liking, having affection for, being drawn or attracted to, or being pleased by" (p. 27). *To have care of* represents having responsibility for or managing the affairs of, in short, taking care of. When people *care about* a person or something, their own welfare is somehow tied to that person's or thing's welfare. And finally, *to care that* is propositional where a specific situation is the object of the statement. Blustein is also quick to note that in varying situations people can experience any and all four of these types of caring. Also, given the above definitions, it is interesting to note how ethics of justice can be seen to slide into each interpretation when we consider a simple change in scale. For example it is quite easy to imagine how someone can care for or about their household pet. But is it also easy to see how someone could care for or about all sentient creatures and thereby establishing the basis for a justice-based perspective on animal rights. We can find a second intriguing example with the propositional interpretation of *to care that*. I can care that my local park may be bulldozed in favor of a parking garage. Similarly I can care that forests in general are being cut. This confirms what Gilligan (1982) suggested that people can care about any number of people and things and to varying degrees.

Ethics of care are often viewed in a dichotomous contrast to an amalgam of western ethics collectively referred to as ethics of justice. This dichotomy is meant to illustrate a number of supposed failures of traditional western ethics to address real moral issues. Where words like contingency, particularity and situatedness describe a care ethic, words like necessity, universality and abstraction describe a justice ethic. See table 3 for an illustration of this dichotomy.

Table 3: A dichotomous contrast between ethics of care and justice.

Ethic of Care	Ethic of Justice
Emotion	Reason
Contingency	Necessity
Particularity	Universality
Situatedness	Abstraction
Equal Consideration	Equal Treatment
Relationship	Individual

At this point, it should be noted that care, as envisioned as an ethical framework, is far deeper than a more superficial view that reduces the word to something akin to kindness or charity. As Plumwood (1998) suggested,

"There is good reason to reject as self-indulgent the 'kindness' approach that reduces respect and morality in the protection of animals to the satisfaction of the carer's own feelings. Respect for others involves treating them as worthy of consideration for their own sake and not just as an instrument for the carer's satisfaction, and there is a sense in which such 'kindness' is not genuine care or respect for the other" (p. 293).

The idea behind this statement is that care should not be envisioned as some tool that a person uses to feel good about him- or herself. Care should be extended without regard to the possible ancillary benefits that might be accrued to the carer.

The focusing on the particular rather than the universal has been explored by a number of feminist researchers. Noddings (1995) notes that in abstracting away from concrete situations, "we often lose the very qualities or factors that gave rise to the moral question in the situation" (p. 85). However, the pairing of emotion with the care ethic and reason with the justice ethic is not as crisp a distinction as it may appear. Gilligan (1993) cautions that care and justice were meant to describe "two moral perspectives that organize both thinking and feelings" (p. 208). It is accurate to say that the care ethic explicitly acknowledges the affection or emotion that humans regularly experience across all situations. This is helpful in considering the place of emotion in ethics because as Kheel (1985) suggests "we cannot even begin to talk about the issue of [environmental] ethics unless we admit that we care (or feel something)" (p. 339).

Perhaps the most important feature of the care ethic is its focus on the relationship as that which deserves moral consideration. Noddings (1995) takes the position that the relationship is ontologically basic, meaning that we must begin from the premise that a fundamental fact of human existence is the human encounter with some other. Further, Gilligan (1982) speaks of the different actors in a moral dilemma not as "opponents in a contest of rights, but as members of a network of relationships on whose continuation they all depend" (p. 30).

It is a curious connection between the relationship/individual contrast of ethics of care and justice and a recent critique of modernity. Taylor (1991) suggested that the "dark side of individualism is a centering on the self, which both flattens and narrows our lives, makes them

poorer in meaning, and less concerned with others or society" (p. 4). Max Weber (1921) noted this shift too from community to society where an emphasis on affective attachments gave way to rationalization. Stated this way, the modern era, with its emphasis on reason, tends to assign greater importance to abstract principles that favor the individual rather than to particular circumstances that define relationships. While some suggestions have been offered to address this problem (e.g., Borgmann's postmodern realism, Taylor's urge towards authenticity), presently the problem persists.

One characteristic of the care ethic that is frequently misrepresented is its exclusivity to females. While it is true that Gilligan set out to respond to a methodologically flawed study of moral development by her mentor, Lawrence Kohlberg, it was not her intent to create an ethic of, by, and for only women. Similarly, while the care ethic is often referred to as a feminist ethic, this terminology reflects its origins rather than its application. In fact, it was found that in the five years following college, both women and men seemed to incorporate more of their previously "limited" ethic (Gilligan and Murphy, 1979). In other words, within five years following college, women incorporated more of an ethic of justice and men incorporated more of an ethic of care. As a result both men and women incorporate more of the "other's" ethic, and each sex becomes more like the other in their moral reasoning. Finally, Gilligan (1993) emphasizes that "the care perspective in my rendition is neither biologically determined nor unique to women" (p. 209). In this respect we need not be concerned with some artificial parallel involving gender (i.e., female/care and male/justice).

Mary Raugust (1996) outlined seven characteristics that concisely describe the care ethic:

1. The central priority of ethics is not the concept of individual rights but of relationships with other human beings.
2. The principle goal of ethics is not autonomy and liberty of individual humans, rather it is "the giving and receiving of care appropriate to specific persons and their situations."
3. Interdependence over individualism.
4. The "other" with whom one deals morally must be distinctly personified and not an impersonal faceless abstraction.
5. Moral judgments emerge from actual situations and are not derived by applying logical formulae to general principles.
6. Feminist ethics are "accepting rather than transformative."
7. Feminist ethics will be a morality of virtues rather than primarily one of justice.

Raugust clearly has in mind relationships between two or more human beings. It is not apparent from her list how natural areas can step in and assume the position of "other" in the relationship. However, the human-human perspective needlessly narrows the moral community. Additionally, while each of these seven tenets has specific application to the central question of this study, the first five seem most worthy of discussion, and will therefore guide this justification.

In reference to tenets one, two, three and five the thrust seems to be directed towards the isolationist qualities of other justice theories, that is to say treating the moral agent as one separate and distinct from the moral dilemma. This suggests Kant's Categorical Imperative suggests that I *Act only in such a way that I can at the same time will that my maxim should become a universal law.* Furthermore, the veil of ignorance developed by John Rawls compels us to make decisions blinded to our own station in life (including gender, nationality, generation, etc.). Thus, we would attempt to remove ourselves completely from whatever moral dilemma that led us to a decision-making scenario in the first place. The care ethic emphasizes the connection between an agent and some specific dilemma that seems to be missing from traditional western systems. Each of these tenets is designed to question the prevailing assumption that ethics can be derived independently of any real moral dilemma.

Upon first glance, tenet four would appear to be problematic for an ethic where the natural world is the "other" in the relationship. After all, how can a place be personified and not be an impersonal, faceless abstraction? In fact, where people are concerned with the well-being of a specific natural area, just the opposite is true: nature is not some faceless abstraction, in fact it is often extremely personal and identifiable to those people who have grown attached to that place.

One question that is necessary to answer at this point is whether a care ethic can truly be applied to relations to place. This question might best be explored through the concept of reciprocity. Andrew (1998) noted that "[c]are ethics has been criticized for lacking reciprocity and for failing to promote freedom" (p. 290). However, Andrew goes on to refute this criticism by referring to one claim of Simone de Beauvoir's *Ethics of Ambiguity*: recognition of others' freedom is the only acceptable moral attitude towards the world. Native American author, N. Scott Momaday discussed the concept of "reciprocal appropriation" to describe the human-nature relationship. Reciprocal appropriation represents a two-way relationship between the landscape and a person, where "man [sic] invests himself in the landscape, and at the same time incorporates the landscape into his own most fundamental experience"

(Momaday, 1993, p. 102). Noddings (1995) explores the concept of reciprocity in depth and makes it clear that "reciprocity on the part of the cared-for is crucial to caring because caring must be completed in the other" (p. 65). However, this reciprocity should really be interpreted to mean simply responding favorably and not some literal tit-for-tat. In fact Noddings is quick to set apart her concept of reciprocity from the type one might find in Plato or Rawls.

Rawls' ethic is primarily a contractual ethic based on mutual consent of all parties. Clearly the natural world cannot explicitly offer its consent and thus cannot be considered as an agent in some environmental ethical dilemma. Rawls himself acknowledges that "we have not yet worked out the metaphysics of our place in nature" (p. 512). However, a natural area that flourishes as a result of care indeed could be seen to be participating in a caring relationship based on reciprocity rather than a contract. King (1991) suggests no need for the object of care to reciprocate in kind, although he does expect care to result in some benefit to natural areas. Admittedly measuring benefit from care would be infinitely complex if at all possible. However, might we reverse the concept and measure benefit as the absence of some range of negative consequences? For instance, animals not displaced as a result of development would be considered a benefit of caring. While empirically difficult, it would be remiss not to attempt to measure a relationship of care, perhaps in terms of benefits.

Are Care and Justice Distinct Ethical Frameworks?

One important concern that should be addressed at this point is the actual distinction between ethics of care and justice. It has been suggested that viewing these two frameworks as discrete systems may be misleading (Lourenco, 1991). This concern returns us to the perspectives by Kohlberg and Gilligan. Recall that Kohlberg outlined six stages of morality. And within these six stages are features of care. Kohlberg (1984) noted that ethics of justice and care should not be conceived of as entirely different tracks of moral development. In response to the concerns raised by Gilligan, Kohlberg suggested that "at the post-conventional stages there is typically an effort to integrate concerns of benevolence and care, on the one hand, with justice concerns on the other" (*ibid.*, p. 356). Gilligan (1982), however, does contend that justice and care define two different and distinct ethical frameworks.

Interestingly, Jean Piaget (1932), who strongly influenced Kohlberg, suggested that there are two moralities: a morality of good and a morality of duty. In Piaget's version, ethics of duty might be termed *perfect duties*: obligations to practice something all of the time. Ethics of good might be termed *imperfect duties*: these are conditional and need not be practiced all of the time. Typically, perfect duties are worded negatively: don't kill, don't steal,

etc. Imperfect duties, also referred to as supererogatory ethics, are typically positively worded: promote happiness, protect equalities. Conceived this way (good/imperfect/care vs. duty/perfect/justice), we concur with Gilligan, that care and justice do indeed represent two distinct moral orientations. That said, we suggest that people rely on each orientation depending on the presentation of the moral dilemma. This position is supported by Killen (1996) who suggested that people do indeed employ both ethical frameworks; choosing which one is more appropriate depends on the moral dilemma at issue.

Implications for Low Impact Behavior

That we are focusing on care and justice as two important aspects of environmental ethics reflects the traditions of these two perspectives in determining what is always right from what is always wrong and what may be right or wrong depending on the circumstances. We propose that people who employ justice-based language in defending or refuting some management action may do so because they are less familiar with the complexity of the management situation. Whereas, we propose that people who are most familiar with an area and its unique management challenges may turn to care-based language. The importance of this distinction from a managers perspective is that justice-based ethics are considered timeless and not subject to change. Thus, someone who opposes off-road vehicle use for justice-based reasons is less likely to change his or her ethics. Conversely, someone who opposes manager ignited fire for care-based reasons may be more amenable to change his or her ethics if this person becomes more familiar with the circumstances surrounding the decision. That people may opt for justice or care can be considered a reflection of a more global concern: the ability of people to spread their limited interests over a wide range of issues. The zero-sum hypothesis reflects this limitation.

The zero-sum hypothesis suggests that if resources (cognitive, emotional, financial, available time and energy, etc.) are directed towards one particular area, all other areas that could receive those resources will not. Relating this concept to justice and care, a justice-based ethic requires less cognitive effort because the principles by which one makes decisions are derived a priori to any information about a specific dilemma. On the other hand, a care-based ethic necessitates a thorough understanding of a dilemma and those who may be affected by any given action; as a result, this ethic requires much more cognitive effort.

The reality is that managers are faced with an audience who not only have limited attention and limited cognitive resources to contribute to low-impact decisions, but also different moral imperatives. That is, in a given situation some visitors will fall back on justice-

based reasoning while in the same situation other visitors will be operating from a care-based perspective. This is problematic since any educational or communication effort from the land management agency is, in itself, an expression of ethics and how the agency would wish the world to be.

It is not just the policies of the administration but also the reasoning used to communicate those policies that express the appropriate relationship of the visitor to the resource. For example, reliance on justice ethics, with its emphasis on rights-based reasoning, will encourage the visitor to think about the responsibilities and duties that go along with the right to visit. Failure to meet those responsibilities are likely to be met with punishment or removal of rights to access the resource. Thus, it is expressed that it is in the visitor's best interests to follow the guidelines being provided.

For justice-based appeals for compliance with low-impact practices, Kohlberg's stages of moral reasoning provides good guidance. Each of the levels offer an increasingly wider sphere of duty and abstract responsibility. Educational efforts should include persuasive arguments in each level: 1) referring to the avoidance of punishment from a legal authority, 2) with direct self-interest consequences, such as more pleasant and satisfying conditions, 3) connecting to the interests of family and friends, such as maintaining the possibility of continuing acces, 4) inferring approval of other members of society, perhaps invoking a sense that others are watching, 5) notions of fairness to all and protecting the resource to ensure that there is enough to go around, and 6) eluding to duties to abstract responsibility as an enlightened being.

However, if the agency is looking to provide and foster relationship between the resource and the visitor, then the use of care-based reasoning is more likely to lead to greater attachment to the place. Visitors responding to care-based arguments are more likely to respect and do no harm to the resource without any expectation of benefit or gain. Instead of treating the natural environment as a faceless non-specific abstraction, care ethics aims to build connection and familiarity with specific locations.

It should be emphasized that neither justice-based nor care-based ethics can be considered the single best approach. Managers need to carefully consider the consequences of relying upon only one approach. Many visitors have solid justice-based value systems that appear rational and reasonable. These visitors will respond best to being told that environment is worth protecting by legal definition, that it is the visitor's duty to contribute to that protection, and that the agency has the role of instructing and enforcing correct behavior. However, in situations where low-impact behaviors are not explicit and perfectly stated, where

the self-interest and rights are unclear and / or dispersed, and where punishment and social disapproval is unlikely, then compliance will be lower.

Similarly, visitors with predominantly care-based value systems will respond best to requests to give every situation careful consideration and to protect those resources which they recognize as being of merit. As familiarity and connection to the resource increases, the imperative to protect will grow strong. Visitors can, therefore, respond well to non-specific directives if emotional and virtuousness arguments are emphasized. In areas where a long-standing relationship to place is the norm, there is reason to believe that care-based arguments are more respectful and influential, whereas in areas which receive a majority of first-time visitors justice ethics of abstract, concept-related arguments will be more effective.

Chapter

5

EXPRESSION OF BEHAVIOR

SOCIAL PROCESSES

A. Introduction

The focus of this section is an examination of social influences on the expression of judgments and behaviors within recreational settings. Specifically we will describe the possible applicability of several concepts affecting decisions related to low impact behavior. At the heart of this discussion is the possibility that recreationists may believe certain things, or report certain attitudes regarding a behavior, and react in ways contrary to these beliefs or attitudes. This discrepancy between attitudes, beliefs and actions may be the result of efforts to maintain aspects of their personal identity, to manage the impressions that others may have toward the recreationist, to present a certain role in a social setting, or as a response to the social elements at work in a particular setting. These elements may have important influence on the actual behaviors observed – behaviors that may be at variance from stated attitudes or received information.

The interactions between elements of the self and the social context have been discussed in the social psychological literature for many years. However, some of these concepts have received relatively little attention in the recreation literature. This section will provide a brief overview of the foundational research that has led to formulations of theories and concepts related to these interactions of the self and the social context. Five topics appear to have particular relevance to this low impact behavior, including: "self-monitoring", "impression management" "the dramaturgical self", "arousal attributions", and some elements of social pressure or normative interactions.

B. Self Monitoring

A major question guiding research into the relationship between attitudes and behavior concerns the extent attitudes are either consistent or inconsistent with subsequent behaviors. That is, do causal links exist between attitudes and behaviors or are human behaviors in social settings sensitive to situational factors that make identifying clear causal links between attitudes and behavior problematic? It has been suggested that both attitudinal influences and social factors contribute to actual behavior in ways that are dependent upon individual conceptions of self (Bem & Allen, 1974; Derlega, Winstead, & Jones, 1991; Snyder, 1974; Snyder & Swann, 1976; Snyder & Tanke, 1975). Specifically, individuals might differ in the relative weight that they place on internal states (such as attitudes) or external social conditions.

Description of the Concept

The concept of self monitoring has been advanced to describe these differences. "According to this formulation, an individual in a social setting actively attempts to construct a pattern of social behavior appropriate to that particular context. Diverse sources of information are available to guide this choice, including (a) cues to situational or interpersonal specifications of appropriateness and (b) information about inner states dispositions, and attitudes" (Snyder & Swann, 1976 , p. 1035). The difference between individuals, according to this conceptualization, lie in the relative weight that is place on each of these two sources of information.

If the actions of a person are primarily guided by the situation-to-situation demands, then correspondence between attitudes and behavior can be minimal. On the other hand individuals who are focused more on interpersonal information will tend to exhibit more congruence between attitudes and behavior. Thus, this concept relates to the locus of influence for the determination of behaviors in social settings. Particularly it relates to the extent to which an individual monitors the social environment and adjusts their behaviors accordingly. This monitoring involves dispositional factors such as attitudes and beliefs, and situational factors such as group expectations or norms (Bem & Allen, 1974; Snyder & Monson, 1975).

There has been a distinction between high and low self-monitors as an individual trait. There are both social and behavioral implications of this distinction. People with high levels of self-monitoring are more likely to adjust behavior to meet particular situational requirements than low self-monitors. Low self-monitoring individuals will base their behaviors on internal

states more that high self-monitors. An early study by Snyder and Tanke (1975) provided "suggestive evidence that the social psychological process of self-monitoring moderates the relationship between behavior and attitude (Snyder & Tanke, 1975 p. 514). These differences related to individual characteristics of the recreationist and seem to be closely related to a persons tendency to be self-focused in a greater or lesser degree (Fenigstein, Scheier, & Buss, 1975).

Individual differences in self-monitoring not only influence the impact of situations on the individual but have also been seen as influencing the social setting itself, or the choice of social settings by a individuals. In the first instance, early research suggested choice of activity partners was related to level of self-monitoring. Specifically, high self-monitors were more likely to choose activity partners who had high levels of skill in particular types of activities, while low self-monitors were more likely to choose activity partners on the basis of general feelings or how much they liked their friends (Derlega et al., 1991; Snyder, Gangestad, & Simpson, 1983).

The selection of social situations also relates to characterizations of setting. Certain settings can be seen as more or less conducive to either high or low self monitoring. Settings could thus be characterized by the extent one is able to focus on either inner states our external demands (Snyder & Swann, 1976). Does the situation afford the opportunity for an individual to reflect on his or her values, attitude, and beliefs, or is the individual forced to primarily focus on coping with the particular demands of the situation?

Implications for Low Impact Behavior

As discussed in an earlier section of this report, much of the work on the nature of low impact behavior has relied on determining attitudes relevant to low impact actions and then determining the relationship between these attitudes and actual behaviors. Since the concept of self-monitoring was developed within the context of social and psychological attitude/behavior research, individual engagement in self-monitoring could help to explain some of the discrepancies observed between attitudes and behavior. Examinations of compliance or non-compliance with low impact recommendations have focused on the individual actor within outdoor recreation settings. Consistent with notion of planned behavior (Fishbein and Ajzen, 1975) the influence of social concerns and significant referent groups has been included. Individual differences in self-monitoring may provide information regarding the interaction of persons to these social contexts.

The concept of self-monitoring suggest that the actual *in situ* behaviors may be significantly influenced by the social dynamics found therein. Individual compliance, or lack of compliance with low impact recommendations may be influenced by self-monitoring factors. Thus, actual behaviors may be the result of the particular group proclivities. High self-monitors may seek to recreate with others who they see as highly skilled in the particular activity. They will tend to follow the behaviors of the group even if those behaviors run counter to attitudes they may have expressed regarding low impact procedures. Thus informational treatments aimed at effecting attitude change within this population of high self-monitors may be ineffective. For recreationists that tend to be low self-monitors, the most important aspect of the social setting for influencing congruence between attitudes and behaviors might be the provision of recreational opportunities characterized by reflection and lack of stress. This subgroup of recreationists may be more consistent in their attitude-behavior relationships and thereby better candidates for educational treatments regarding low impact behaviors.

The concept of self-monitoring suggests several possible barriers to compliance with low impact recreational behaviors. Informational efforts to promote low-impact practices could be superseded by self monitoring dynamics within recreational settings. Even if a person "knows" what they should be doing in the situation, proclivities toward high self monitoring might create a situation where actual behaviors are dictated by the social group. Thus, self monitoring becomes a potential barrier to low-impact practices that is overlooked by focusing on traditional persuasive communications and individual attitude change. This is primarily because self monitoring creates a situation where people will act in a way that is counter to the attitudes one may hold.

C. Impression Management

Theoretical Roots: Symbolic Interactionism & Dramaturgical Self

From the field of sociology comes the roots of both self-presentation and impression management. Specifically, symbolic interactionism (most notably the work of G.H. Mead) and notions of dramaturgy (E. Goffman) offered important insights into how "the self ... becomes in part a reflection of the reactions of others [and how] these reactions of others can be partially controlled by instrumental actions of the self" (Jones, 1990, p. 172). These theoretical approaches have provided an important perspective on the relationship between the self, social meanings, and interactions between individuals. Although a full treatment of

symbolic interactionism and role theory is beyond the scope of the current report, a brief overview here will serve to place the notions of self-presentation and impression management in their proper theoretical context.

Symbolic interactionism is an approach focused on the dynamics of social roles and emphasizes the processes whereby individuals negotiate their interactions based on the symbolic meanings they share, and create, in social settings. "Symbolic interactionism emphasizes that human society uses symbols and meanings, and behavior is based on these meanings" (Colton, 1987, p. 346).

The work of George Herbert Mead has been pivotal in the articulations of concepts that later formed the basis of symbolic interactionism. The fundamental problem which engaged Mead was a daunting one, namely to examine the relation of the individual to the whole of things. One of the major results of Mead's perspective is to place the individual, and the individual's present perspective, at the center of reality. Human experience is not determined by some undeniable set of causes. Neither is human experience simply a striving toward some ultimate future reality. Rather the human experience is an evolving, creative reality that functions within the context of human history. Thus, human experience is a *lived* experience. Mead sought to understand how humans actively define their relationships, behaviors, and existence in terms of social and natural environments (Mead, 1932; Mead, 1934; Mead, 1938).

This description of the nature of human interaction was based on Mead's understanding of the development of the self. For Mead the self emerges from social interaction.

> "The self ... becomes in part a reflection of the reactions of others to us. It is but a small step to realize that these reactions of others can be partially controlled by instrumental actions of the self" (Jones, 1990, p. 173).

A person defines one's self by first taking the viewpoint of others – seeing ones self as an object – then assessments of how others react to that self in turn refines the definition of self (Anson, 1974; Blumer, 1969).

Social interactions, then, become important not only for defining who we are as individuals, for the development of meanings within situations, and for understanding how those socially constructed meaning influence behavior. The implications of this conception of social (symbolic) interaction are that "individual perceptions of the social structure (others) must in some way be reckoned with in explaining behavior, second, that structural variables

determine the various ways the individual perceives himself and third; behavior is a function of both structural and personality factors" (Anson, 1974, pp. 172-173).

The attention to social roles, and the construction of the self through social interaction has been foundational in the development of theories of social structure and their links to behavior (Jones, 1990). Erving Goffman used the language of the theatre to describe the interactions of roles in social settings (Goffman, 1958; Wallace & Wolf, 1991). The concepts of "dramaturgy", along with symbolic interaction and role theory, were influential in the development of the concepts of self-presentation and impression management. This approach analyzed human behavior in terms of individuals who act out different roles in different situations. The goal of acting in specific ways, and at specific times, is to manage the impressions of other regarding one's self. A distinction was made between the concepts of "front" and "back" regions of the dramatic situation. Front regions are associated with the performance of roles that are defined by the situation. These are public roles; the face that we put on for others in a social setting. The back region are the supporting roles that are in a sense "backstage". They are the roles more associated with the personal attributes of an individual. The ways in which people negotiate these roles have potentially profound influence on the behaviors that are actually exhibited in a social setting.

D. Self-presentation and Impression Management

A closely related social context issue, with possible applications to low impact behavior compliance, involves the presentation and management of social self impressions and the effect that these impression management efforts have on the expression of actual behaviors. Individuals in social settings seek to present an image of who they are. Presentation of images of ones self is important as a means of expression but is also a way to function within the social setting, to obtain rewards, or avoid sanctions. Individual efforts to please an "audience" have a potentially profound implication for compliance, or non-compliance with low impact behavior recommendations.

Description of the Concept

The concept of impression management is concerned with how individuals behave in a social setting. Particularly, the focus is on how people adjust behaviors to either present an ideal conception of who they are, or behave in such a way that is deemed acceptable to others. Thus, "Impression management or self-presentation is the process of presenting a public image

of the self to others. It is assumed that people seek to maximize rewards and minimize costs in a situation and, in particular, to obtain social approval and avoid disapproval" (Turner, 1991, p. 124). The process of impression management functions to present information about the self. Self-presentations can also have an influence on the developing conceptions of the individual self or they may affect how an individual responds to cognitive dissonance associated with behaviors that might be at odds with internalized attitudes or values (Fleming & Rudman, 1993; Aronson, Blanton & Cooper, 1995).

Impression management is a form of social interaction that is actually a subset of the process broadly described as "self presentation". Self-presentation has been defined as "the use of behavior to communicate information about oneself to others (Baumeister, 1982, p. 3). The primary motivations for these behaviors is to please an audience, (or gain rewards by influencing others), ad present an image of self to others, (or managing a public impression that is congruent to one's ideal self) (Baumeister, 1982; Fleming & Rudman, 1993; Gergen, 1965). Impression management is most often associated with the motivation to please a particular audience and thereby gain rewards in this social context.

The assertion that people present images of themselves in social situations in order to meet demands of those settings has been fundamental to much of the literature on self and social interaction (Gergen, 1965; Goffman, 1958). A person in a social situation may behave in a particular way to obtain the rewards of that social group even if the behaviors that the individual engages in run counter to internalized attitudes. In the context of low impact behavior, for example, a person might bow to the pressure and or expectations of the group and forego practicing low impact behaviors. Individuals may have effective ways to buffer their own sense of self in the face of these counterattitudinal or self-discrepant behaviors (Davis & Jones, 1960; Fleming & Darley, 1989; Fleming & Darley, 1991; Fleming & Rudman, 1993) or the cognitive dissonance associated with these behaviors might occasion changes in a person's attitudes.

Efforts to present a public impression that is congruent to one's ideal self has been describe as "self-constructive self-presentation" (Baumeister, 1982, p.4). The focus of these presentations is toward some general audience and is aimed at impression upon that audience the personal traits and qualities that an individual most wants to define him or herself. These types of self presentation are generally much more consistent across situations since what is presented is the *desired* or *ideal* self as defined by the individual. Self-presentation, thus, plays a role in the development of the self. However, "Creating the self is a matter of self-

presentation only insofar as it is concerned with establishing and maintaining one's public self, that is, the image of oneself that exits in the minds of others" (Baumeister, 1982, p. 4).

As a person presents him or herself in a social situation the presentations may come to be internalized. That is, "by acting as if we possess a desired trait, we may actually come to possess it" (Fleming & Rudman, 1993, p. 44). There has been considerable examination of the extent to which the self is either a product of social interactions or relatively stable over situations and time (Baumeister, 1982; Bem & Allen, 1974; Cooley, 1902; Gergen, 1965; Goffman, 1958; Mead, 1934; Rhodewalt & Agustsdottir, 1986). Within this context a large body of research has examined the ways that outward behavior influences the construction of the self. Self-presentations have been a major part of the ways that people internalize externally imposed constructs (Baumeister, 1982; Baumeister, 1986; Baumeister & Tice, 1986; Gergen, 1965; Jones, 1990; Rhodewalt & Agustsdottir, 1986; Schlenker & Trudeau, 1990; Upshaw & Yates, 1968). The thrust of this research suggests that, in many ways, we become who we present ourselves to be. Also, much of the changes result from a person's tendency to reduce feeling of dissonance associated with public behaviors that may be different than our private conceptions. Dissonance reduction in this context becomes a major force of change in the individual.

Changes in attitude associated with cognitive dissonance have been the subject of research for over thirty years. Researchers have attempted to identify the that lead to attitude changes in the face of inconsistencies between public behavior and internal attitudes and values (Aronson, Blanton, & Cooper, 1995; Brehm & Cohen, 1962; Cooper & Fazio, 1984; Festinger, 1957).

Another approach to cognitive dissonance has placed the issue within self-esteem maintenance (Aronson et al., 1995; Greenwald & Ronis, 1978; Steele, 1988; Steele & Liu, 1983). It is argued that, "what really motivates individuals to reduce dissonance (by means of attitude change, etc.) is not the inconsistency but rather the negative light that inconsistency casts on the self-image" (Aronson et al., 1995, p. 986). Thus, the inconsistency and resulting cognitive dissonance is the catalyst for adjustments to attitude because an individual wishes to maintain impression of him or herself in a social context. "If dissonance is aroused by threats to one's general sense of self-integrity, then people can effectively respond to these threats in ways not documented by the early dissonance researchers – that is, by affirming some valued aspect of the self-concept not necessarily related to the threat" (Aronson et al., 1995, p. 986). The implication here is that the dissonance reduction afforded by self-concept affirmations

may explain some of the durability in attitude even in the face of obvious dissonance producing situations.

If reduction in dissonance, such as attitude change, is indeed related to affirmations of self-concept, then differences in individual self-concept might be responsible in part for differences in personal changes of attitudes in particular situations. Positive self-conception and higher levels of self-esteem by an individual would create a situation less likely to produce rationalizations. Individuals in a situation that produces dissonance may perceive a threat to their conceptions of self, but individual differences in self-focus "can reduce the perception of self-threat, producing a self-affirmation effect...[or] increase the perception of self-threat, resulting in a self-discrepancy effect (Aronson et al., 1995, p. 987). Thus, dissonance reduction can be seen as an attempt to maintain an appropriate self-image to others, and is influenced both by differences in relative levels of positive or negative self-concept and degree of focus upon one's self.

The concept of self impression management, while providing important insights into the relationship between self and social context, have been criticized as offering an essentially post-hoc analysis of all behavior. That is, virtually all actual behavior could be described as self presentational and, thus, the concept does not really help to differentiate behaviors. Also, many approaches to impression management have ignored aspects of the group self, and issues of self development associated with social context. "Intra-personal psychological processes are not merely constrained by the social context but actively function in interplay with it. Social influence is not merely compliance, but also gets to the psychological core of the self" (Turner, 1991, p. 131). Efforts to describe the interplay between fundamental psychological processes of the self such as those offered by Aronson and others represent a partial response to these criticisms

Taken together, this approach places concepts of self presentation and impression management in the center of processes affecting attitudes, attitude change, and behaviors. Notions of self and impression management provide an important area of inquiry when examining changes, or lack of changes, in attitudes for individuals in situations where actual behaviors may produce dissonance. Compliance, or non-compliance with low impact camping recommendations may produce situations where actual behaviors may be at odds with attitudes, and thereby producing dissonance. In this context the concepts of impression management and self-presentation should be taken into account.

Implications for Low Impact Behavior

The concept of impression management may aid the assessment of discrepancy between what visitors may "know" about low impact behavior and the actual actions exhibited in recreational sites. For recreationists that engage in outdoor recreation activities as members of a group (the vast majority) this concept may have particular applicability. Impression management not only helps to describe the influence of self and self-concept on the formation of judgments regarding *in situ* behaviors, but it also offers possible avenues for understanding the processes associated with attitude change and cognitive dissonance.

In terms of judgment formation, a recreationist who may have internalized positive attitude regarding low impact camping behavior, may elect to ignore those behaviors in order to gain social rewards within their group. This effort to manage an impression of the self that is acceptable to the group may represent a significant impediment to the practice of low impact behaviors in some social setting.

In contrast to this situation, for individuals who identify low impact camping behaviors as part of their idealized self-concept, this tendency to manage self-impressions could have a positive influence on the practice of low impact behaviors. For some individuals, engaging in low impact behaviors while in the backcountry is a major defining element of who they see themselves to be. These individuals will not only be more resistant to the social context pressures to act otherwise, but they may also have self-constructive behaviors in order to project this ideal self concept to the social group.

Moreover, the practice of behaviors that are associated with impression management may serve to reinforce those behavior for the individual. That is, if a person chooses to adopt low impact behaviors, or to ignore those behaviors, for the sake of managing their impressions within a social group, the course of action adopted for impression management may become integral to their self concept. Insofar as this situation exists, changing behaviors will be difficult once they are adopted.

Finally, the concepts surrounding impression management could help to make the possibility of sanctions and enforcement of low impact behaviors more effective. A study by Gramann, Bonifield and Kim (1995) examined the role of "awareness of consequences" and "presence of probable and significant sanctions" for violating rules in the context of obeying outdoor recreation regulations. They concluded that:

> Subjects who received a message informing them of probable sanctions for rule violations were more likely to intend to obey regulations than those who did not

receive this message. Awareness-of-consequences information also promoted rule obedience, especially among high social-responsibility subjects.

The concept of impression management is consistent with these findings. Individuals seek to gain a reward from their social context may do so by presenting a managed impression of their self by conforming their actions to expectations. So, as long as those sanctions are perceived as real and imminent the behaviors may persist. Repeated engagement in appropriate behaviors may also influence an individuals definition of self such that these behaviors then become internalized.

The study by Gramann, Bonifield and Kim (1995) also concluded that pro-social behavior, or spontaneous helping (Grace, Bell, and Sugar, 1988), was an important element of compliance regulations in recreation areas. Specifically, if the individual was aware of the negative consequences for the environment by disobeying rules, then he or she was more likely to engage in prosocial behaviors. It is quite possible that individuals who responded to educational treatments aimed at identifying negative consequences of disobeying rules, were ones who associated protecting the resource as part of their idealized self-concept. Engaging in prosocial behavior could be an instance of self-presentation and self-construction in a social context.

E. Normative Influences

So far we have discussed the concepts surrounding the interaction of the self in social settings and how those interactions both influence behavior and definitions of the self. Another approach to understanding this social interaction is to examine normative influence upon attitudes and behaviors directly. The study of normative influences has been a major area of focus in sociology and social psychology for many years. The questions encompassed by this research effort have important applications for understanding elements of compliance to low impact camping practices within recreation settings.

Description of the Concept

John Turner, in his examination of social influence, highlights a dual process model for understanding the processes associated with normative influence on both public and private conformity (Turner, 1991). In understanding social influence the dual-process model has been the dominant theory. Development of the model is attributed first to Deutsch and Gerard

(1955), but was both anticipated by Festinger's theory of social reality and group locomotion (1954) and enhanced by the work of Asch through his insistence that social influence is more complex than simply submitting to social pressure (Asch, 1956; Festinger, 1954; Turner, 1991).

Perhaps the most important theme in a dual-process model of normative influence and compliance is the distinction between normative and informational influences. The normative influence refers to conformity by individuals in social settings that is based on what other members of the social group expect. Changes in behavior as a result of these expectations represents an effort on the part of an individual to gain approval, or avoid disapproval and rejection by, other members of the social setting. This process has been characterized as one based on power.

The second process in the dual-process model focuses on conformity that represents actual or "true" conformity. That is, conformity by an individual corresponds to changes in a person's view of what the nature of the world is really like. "Informational influence is conformity to others' behavior as information about reality in order to cognize and act correctly, appropriately, to be right, or in Festinger's terms to achieve subjective validity" (Turner, 1991, p. 144). This type of conformity is seen as "true" because it represents actual changes in the individual, based on cognitive processes and internal motivations rather than some external, power-based, source of motivation for conformity.

Impression management efforts, discussed earlier, can be understood within the context of this dual-process model of conformity. Taking the distinction between public and private behaviors relative to conformity, the notions of normative and informational conformity seem to fit well. Public presentations of the self, or impression management, can be seen as approximating the model of normative influence. Here the individual may exhibit socially acceptable behavior, or other presentations of the self, without any corresponding changes in fundamental attitudes or concepts of the self. This type of presentation and conformity rely heavily on surveillance by the referent group or social context. Also, the distinction between front and back stage roles in dramaturgy fit well with the public/private and normative/informational distinctions within the dual-process model.

Amid the diverse approaches to normative influence there is a major theme that distinguishes between public and private change. Most theories in this area present a "dichotomy between socially motivated normative process of influence affecting the public self and cognitively motivated informational processes affecting the private self" (Turner, 1991, p. 146). This distinction places the influence of normative pressure primarily on public

expressions and behaviors. Thus, the emphasis is on the change in the public self relative to normative pressures rather than private informational influence.

Individual differences in conformity have been observed based on the relative dependence of a person to the group. Variables affecting this level of dependence include: the level of relevance the group poses for the individual, the extent to which the group in consensual on the stimulus prompting conformity or non-conformity, and the relationship that the individual has directly with that stimulus (Turner, 1991).

Turner (1991) summarizes several empirical generalizations emerging from research on congruent behavior and two-process models. First, the overall importance of the reference group, or the extent to which an individual feels attached to the group, will affect conformity. Thus if people feel they are a part of a group, and are also attracted to that group they will be more likely to conform. Also, the level of group cohesion regarding the task or issue, or a strong belief that conformity is required for group membership, will impact conformity.

Second, the level of consensus within a reference group will impact the level of conformity by its members. In this instance "the more consensual the group and the more isolated the individual ... the greater the power of the group to define reality, induce self-doubt in the deviant as to bother her competence and social positions, and threaten her with ridicule and rejection for being different" (Turner, 1991, pp. 43-44). Thus, to the extent that the number of influential sources agree the higher the likelihood of conformity (Wilder & Shapiro, 1984).

Third, in the case of normative influence (external conformity), the extent to which the group surveillance is present (monitoring or observation) influences the level of conformity (Asch, 1956; Deutsch & Gerard, 1955). To the extent that an individual feels removed from scrutiny of the referent group there could be less pressure for compliance.

Fourth, the relative clarity or ambiguity of the task influence compliance in social settings. If the situation places an individual in an unsure state as to what the norms are, or what tasks are required, then resistance to conformity may occur. Thus, an individual must understand clearly what the task requires and what is the normative response to the situation actually is according to the reference group.

Taken together, these generalizations offer several elements of the interaction of groups and their members with regard to conformity to normative and informational influences. Varying degrees of group attachment, consensus, surveillance, and ambiguity will produce situations with more or less pressure for conformity by individuals. This interplay

between the nature of groups, individual responses and conformity have potentially important implications for the behaviors of group members in a variety of social situations.

One of the strengths of the dual-process model is its explanatory power regarding the differences between public conformity based on a response to external pressure and conformity based on more intrinsic changes within the individual. A potential problem with this model, however, is a potential over-emphasis on the ability of norms to influence behavior to the exclusion of an understanding regarding changes in attitude associated with those norms. As Turner points out, "The difficulty with the dual process models are the implication that social norms have no effect on private attitude change and that informational influence is non-normative" (Turner, 1991, p. 147).

At the heart of this potential difficulty is the tendency to view the individual as at odds with society in terms of normative influences. As we have seen in our earlier discussion of symbolic interactionism and the development of self *vis a vis* social settings, the construction of the self is developed in and through the engagement in roles, objectification of the self, and interaction of shared meanings in social contexts. It seems reasonable to suggest that norms can influence the development of individually recognized "correct" beliefs.

> "... it can be argued that informational influence is socially mediated and normative, that norms are preferences and values are informative about appropriate, correct beliefs in the same way and reflect the same processes as norms about facts and demonstrably correct solutions, and that individuals and society are not in antagonism but are interdependent at the level of self and cognition as well as overt behavior (Turner, 1991, p. 147).

This perspective is important because of the stability associated with informational influences.

Stable, persistent change in cognitions regarding appropriate behaviors is a desirable feature from the standpoint of influencing long-term changes in social settings. In so far as these changes can be influenced by both the immediate social context, and through larger social structures, then notions of normative influences become a vehicle for behavioral adaptations to changing situations. The potential applications of this type of normative and informational influence relative to low impact behavior in recreational settings becomes critical.

Research into the nature of social group influence in recreational settings would be enhanced by examinations of the elements of group pressure discussed above. These elements include examining the level of consensus within the groups, the amount of surveillance, or the awareness of group members regarding individual actions, and the level of ambiguity regarding low impact behaviors would give a clue to the potential social influence that might affect behaviors. These factors appear to be determining factors for the level of normative and informational influence that significant referent groups have upon individuals.

Chapter

6

INVESTINGATING LOW-IMPACT BEHAVIOR DECISION MAKING PROCESSES

THINKALOUD METHODS

The think-aloud methodology has been used to observe events that take place in an individual's consciousness. At its core this approach assumes that verbal articulations of introspection and thought processes provide a window on consciousness. Thus, verbal data in the form of recorded think-aloud sessions are used to determine the thought processes that underlie cognitive or behavioral situations. Respondents are told to say whatever comes to mind as they make a decision and thereby generate data that can then be used to infer the underlying cognitive processes. By getting respondents to talk about how they interpret a situation, recall information relevant to the decision, decide upon the information's relevance, formultate behavioral options, and decide to carrying out a chosen alternative, researchers can learn about the processes leading to behavioral expression. Thinkalouds have been used to study human judgment formation and decision making in a variety of contexts ranging from mathematical problem solving to situations of consumer choice (Bickart & Felcher, 1996). Thinkalouds have also seen extensive application to the processes individuals used to answer survey questions, as a means to improving interviews and questionnaires (Schwarz & Sudman, 1996). An annotated bibliography of applications of thinkaloud methods is included in Appendix A of this report.

Thinkalouds are often conducted in laboratory settings with respondents providing verbal protocol data as a result of thinking aloud during the decision making task (and are therefore concurrent methods) or immediately after the task (retrospective methods). Concurrent thinkalouds instruct the respondent to 'think out loud' and to continue to tell the researcher 'what they are thinking'.

Respondents are sometimes probed to say more about specific moments of the decision making process, particularly when the respondent appears to be having difficulty with thinking aloud. Most respondents appear eager and able to thinkaloud and provide verbal data on cognitive processes (Jobe, Keller & Smith, 1996). Retrospective thinkalouds might also include paraphrasing tasks, where they are asked to reword some of their comments to more expand their own interpretation of what they were thinking, as well as confidence rating tasks, where the respondent is asked to rate their level of confidence in the verbal report they have provided. As Groves (1996) has suggested, it is the complement of concurrent and retrospective techniques that best maps cognitive processes.

The use of verbal data obtained from a think-aloud process poses some conceptual problems in the face of accepted behavioral approaches to psychology. Strong doubts have been expressed about the suitability of using verbalizations as data. At the core of this objection lies the reluctance to accept the results of introspection as anything other than data available to a single individual – there is nothing "hard" about the data and it is not available for replication. The result of this problem with introspection is that psychology initially turned away from the study of cognitive processes and focused instead on the study of observable, "hard" data based on human behavior (Ericsson & Simon, 1984; van Sameren, Barnard, & Sandberg, 1994). This also contributed to the focus on behaviorism in the 1930's. This early form behaviorism discounted all theory about what cannot be observed outside the body.

The think-aloud process avoids some of the problems of relying on introspection for insight into consciousness or cognitive processes. The process attempts to avoid interpretation by the subjects and only uses verbal process associated with cognitive tasks. While a subject does a task he or she literally thinks aloud about the process. The classic example of this involves the cognitive processes associated with mathematical problems – addition, subtraction, division, and the like. The subject in encouraged to think aloud without interpretation of the thought process. From these verbalizations protocols are developed regarding the cognitions associated with a particular task. This use of verbal protocols allows the data to be available to anyone and thus produces a more objective method.

Use of verbal reports as data for examining cognitive process began early (De Groot, 1965; Dunker, 1945). Verbal reports were used to describe problem-solving process or thought processes associated with a set of actions like playing chess. These efforts, however, were largely overshadowed by an intense focus on behavioral approaches. At the end of the 1960's there was an increase in interest in internal cognitive processes. To examine this there was a need for a data collection method. Computer scientists began to develop complex models of human problem solving for use in the development of Artificial Intelligence (AI) systems (Newell & Simon, 1972). Artificial Intelligence and expert systems used a combination of experts and structured, prompted interviews. It was plagued

by the problems of both – incomplete analysis of processes and introduced biases. Think aloud was used to avoid the problems of missing important process or artificially focusing on certain processes. "Currently the think aloud method is accepted as a useful method by a large part of the scientific community in psychology and it also has its place in the repertoire of many knowledge engineers" (van Sameren et al., 1994, p. 32).

This acceptance notwithstanding, advocates of the use of verbal protocols obtained using a think-aloud methodology needed to respond to several serious criticisms. Primary among these criticisms is the possibility of invalidity of data on cognition due to a disturbance of the cognitive processes. The danger is that the subject in a think-aloud session may think more about what he or she is reporting than on the cognitions under examination. Thus the act of measuring a phenomenon influences that phenomenon. The possibility of influencing the object of study through the process of examination is inherent in many (if not all) forms of research. In the case of the think-aloud method efforts to eliminate this influence center around procedures that re-focus the attention of the subject on non-interpreted reporting of cognition, efforts to focus the session on the stated object of study, or the use of supplemental methodologies that augment the standard think-aloud procedure.

Another potential threat to validity in the think-aloud method involves possible incompleteness due to synchronization. That is, the verbal process used in the think-aloud session can itself slow down the cognitive processes. Thus the thought process tends to synchronize with the verbal reports. This highlights the possibility that the think-aloud process may truncate the cognitive process, or create gaps in the reported cognitive process.

Although one of the strengths of the think aloud approach is that it does not introduce structure or instructions that interfere with the cognitive processes, modifications to the think-aloud method that involved experimenter intervention can be used to guard against some of these validity concerns. The problem of incompleteness due to synchronization of problems can be lessoned by the use of multiple techniques. In certain situations either the use of questions and prompting or the use of structured dialogue can help reveal the cognitive elements associated with a task. Also, the subject is prompted to "think-aloud" if the structure of verbalizations moves more toward interpretation.

Dialogue observation can also be used to augment an analysis of cognitive processes (van Sameren et al., 1994). Dialogues, although different than individual verbalizations of thought processes, can be helpful in examining certain cognitive task situations. Dialogue can be *induced* in the sense of instructing subjects to describe a task to another person. Also, the task under examination may be such that collaboration among subjects is called for. In this situation the verbalizations in collaborative decision-making reveal element of the cognitive process.

This type of collaborative or natural dialogue about a problem may have applicability to the examination of low impact behaviors. Often the discussions related to low-impact behavior are done in a group setting. Thus the application of think-aloud method to the study of this task might involve classic think-aloud situations augmented by an analysis of the dialogues that occur naturally in decision context. During a trial of the think-aloud method in an actual camping situation it was apparent to the participants that the collaborative nature of the decisions space introduced barriers to clear-cut thinking aloud on personal decisions. In future applications think aloud sessions with individuals presented with the problem of setting up camp, might be augmented with an analysis of the natural dialogue that occurs in a similar situation.

Chapter

7

CONCLUSION

The need for effective communication strategies between natural resource managers and the public they serve has never been greater. Not only is the assistance and cooperation of the visiting public a necessary component for the stewardship of the natural resource, but the support and advice of non-visitors is crucial for continued funding and planning of these resources. The lessons learned from this review of current social and cognitive psychology literatures apply not just to the encouragement of low-impact behavior but also for many other communications to the public.

Put simply, assuming that lack of knowledge by the public is the main factor limiting their compliance with agency wishes may be overlooking many other factors. However, this notion that the public sufficient knowledge of natural resource issues is still prevalent. Many natural resource managers feel that they are misunderstood by the public, and that if only the public knew what the managers did, then the public would most likely agree with managers and behave accordingly. As a result of this believe, managers may believe that educating the public as a means to raising their knowledge levels will be the most effective means to gaining desired support and behavior from the public. For example, fire managers might believe that if only the public understood the biological imperative for fuel reduction activities then the public would be more supportive of fuel reduction activities and endorse the active role of public land managers in these activities.

This may indeed be the case, and natural resource managers should take whatever steps possible to share their knowledge of natural resource issues with the public, as this is an important goal in and of itself and an important component of earning the public's support and cooperation. However, the research survey in this report clearly demonstrates that an educational campaign based only on information dispersal is unlikely to be sufficient. There are many more components to a successful communication strategy, each reflecting social and cognitive factors that can limit hoped-for behavioral response from the public. Simply hoping that the public can, and will, take the provided knowledge and progress efficiently and successfully through the steps of decision making to the desired

choice for action fails to take account of the complexity and difficulty of the decision-making task. Natural resource managers need to take more responsibility for helping the public through all phases of the decision-making process. That is, if managers hope for visitors to comply with guidelines such as low-impact practices in the backcountry, then they will need to put greater educational effort into visitors to make decisions that can lead to low-impact behaviors. There are many factors described in this report that need attention for any educational effort to be as successful and persuasive as possible. Indeed, failing to consider some of these limiting factors may undermine the impact of information dispersal efforts and, in effect, perpetuate counter productive attitudes and behaviors.

SOME GUIDELINES FOR EFFECTIVE COMMUNICATIONS

There are, perhaps, some very general guidelines that are suggested by our review of the psychological literature. Table 3 provides a summary of some of the main principles suggested by each of the sections of this report. These principles provide recommendations for natural resource managers in preparation of communications with the public. It can serve as a reminder of how to more successfully influence public attitudes & behavior, and how to build upon successful information campaigns. In many ways, the Leave No Trace program illustrates these principles for encouraging low-impact practices in wildland settings.

For example, in encouraging low-impact practices educational and informational campaigns need to include instruction on when low-impact practices can make a difference. The public needs to know when and where there are potential actions they can take to minimize their impact. Researchers and managers can help by identifying simple, unambiguous environmental cues that signal a decision might be made between alternative behaviors. These environmental cues should be related to the more important criteria that visitors will use to differentiate low-impact practices. In this way, by attending to these environmental cues, visitors will be most ready to make behavior choices that are clearly linked to minimizing impacts.

Similarly, educational and informational campaigns not only need to focus on what they are communicating but also on how that communication is conducted. These means of communication clearly influence how easily the information and attitudes are learned and then remembered. For example, the use of face-to-face contact and direct, in-context training is clearly preferable. But, all media channels are worthwhile (in-person, audio-visual, printed, etc.), and a reliance upon any single option (eg. brochures and trailhead bulletin boards) is unlikely to be effective. Consistent principles should be introduced and reinforced in a variety of outlets. In each case, the authority, credibility, and

attractiveness of the message source should be carefully maintained. Leave No Trace programs, for instance, should be cautious in their association with law enforcement agencies and corporate sponsors (which may have negative connotations for some visitors). Similarly, the use of legal and bureaucratic terminology can trigger unwanted associations. The potential for these associations and connotations to undermine and short-circuit the motivation and recollection of low-impact practices is partly due to the cognitive structures and short-cuts used to more efficiently deal with complex and ambiguous situations.

TABLE 3. SOME SUMMARY RECOMMENDATIONS FOR EFFECTIVE NATURAL RESOURCE COMMUNICATIONS.

- INTERPRETATION OF SITUATION
  - Teach how to recognize situations where public behavior impacts natural resources
  - Instruct what the public should most be paying attention to (environmental cues to choice situations)
- INFORMATION RETREIVAL STRATEGIES
  - Carefully maintain message source credibility & attractiveness
  - Emphasize face-to-face communication & direct experience with suggested behavior
  - Reinforce consistent principles of action
  - Illustrate prototypical situations & desired stereotypical behaviors
  - Match level of specificity of motivations to act, attitudes & behaviors in all communications
  - Avoid bureaucratic, legal & overly technical language
  - Avoid negative connotations & associations
- JUDGMENT FORMATION
  - Emphasize planning & preparation to allow sufficient time for consideration & decision making
  - Clearly illustrate direct link between public actions & impacts on natural resources
  - Emphasize individual responsibility & accountability for actions
  - Make desired actions quick & easy by removing administrative & operational barriers
  - Utilize both care-based and justice-based ethical reasoning
- EXPRESSION OF BEHAVIOR
  - Encourage & foster community development and adoption of codes of practice
  - Utilize opinion leaders & well-known role models to endorse and promote behaviors
  - Foster norm of adoption of practices
  - Get community & educational organizations to actively adopt and train attitudes & behaviors

Another example for low-impact practices is the need to make these behaviors easily and quickly chosen. Managers should take whatever steps they can to remove barriers to the desired behavior. The general principle is to make it easy and worthwhile for visitors to comply with recommendations, instead of just expecting them to do so. In high-profile destinations, for instance, the location of trails can direct visitors first to preferable campsites, thereby increasing the probability that

those low-impact campsites will be chosen. Pointing out recommended alternatives when the most obvious alternatives are not the low-impact option will only be effective when the desired alternatives are easily and quickly accessible. Educational campaigns should also include illustration of the extent and irreversibility of impacts caused by visitors who fail to follow recommended practices. This highlights each individual is responsible and accountable for the impacts their visit entails. Instead of careless, uninformed actions, most visitors wish to minimize their impact. This can be reinforced by both rights-based or justice ethics, as well as relationship-oriented, care ethics. Different visitors to backcountry destinations will have different ethical foundations for their motivations to follow low-impact practices, and education campaigns should reinforce and recognize both ethical approaches.

One final example for low-impact practices is the construction of codes of behavior developed by mountain bike groups. These codes create the impression that most mountain bikers follow these behaviors that are in their own best interests (as compared to being imposed from outside biking community). Backcountry bikers will feel normative pressure and social desirability to follow these codes of practice. This can be reinforced by role models and opinion leaders in the mountain bike community prominently endorsing and practicing low-impact behaviors.

More details for low-impact education efforts can be found throughout the previous chapters. Taken together, they suggest that more effective communication strategies are possible for natural resource managers.

INVESTIGATING FACTORS THAT LIMIT LOW-IMPACT PRACTICES

This study has been largely a theoretical survey of research in social and cognitive psychology and its potential significance and application for low-impact practices. Clearly more investigation and documentation of the processes involved in low-impact practices is required. To our knowledge, no studies have examined the complete decision-making process from the identification of the need for low-impact practices through to the conduct of those practices in social circumstances. While studies that look at individual components of one of the four stages of decision-making are valuable, there is also need for validation and understanding of the complete range of cognitive process that wildland visitors must undertake in choosing low-impact practices.

We believe that thinkalouds provide much promise for further understanding of low-impact behavior. However, significant challenges are involved in the application of this established methodology to wildland recreation contexts. In our experimentation with these methods in both the laboratory and field locations a clear tension between experimental and ecological validity was encountered. That is, while field locations have ecological validity (being in the real-world context of

interest), there was less ability to control the experimental conditions of the thinkaloud method. In particular, the issue of behavioral reactance is a concern whereby the thinkaloud changes the decision-making process. For example, in a wildland setting, one of our respondents expressed concern about when to turn on the tape recorder and begin documenting a potential low-impact decision. Given that the researchers were not present, this decision itself consumed cognitive energy and perhaps is part of the first stages of decision-making. Given their consternation the respondent felt their subsequent decision was given greater importance and was therefore not 'natural, but instead somewhat 'forced'. Their decision make have been more considered, more careful, and more justifiable.Some of the benefit of being in the wildland setting was lost as the artificial constraints of the method imposed itself upon the context.

In the laboratory, on the other hand, it was difficult to capture and provide to respondents all the complexity and detail of the decision context. While the boundaries of the decision-making process are clearly designated and controlled, even the use of video techniques are less able to provide all of the social and environmental cues that would be available in the real world setting. Indeed, the researcher must decide what cues are to be available in the preparation of the video or other visual materials provided or described to the subject. This is less of a problem in typical thinkaloud contexts, such as mathematical problem solving or consumer choice situations, but is likely to be critical for low-impact behavior contexts. For example, we are concerned that respondents will recognize cues more easily in the laboratory than in real-world settings, and use that ease of recognition as a heuristic towards making a decision.

However, from our experience it is crucial that the researcher play an active role in administering thinkaloud methods. Not only can the researcher take responsibility for recording the thinkalouds (thereby removing that dilemma from the respondent), but they can also provide prompts to think aloud throughout the concurrent experiments. Immediately retrospective thinkaloud methods are also possible if the researcher is present in context. Our experiments with these methods emphasized the need for clear training and practice with thinkalouds prior to recording low-impact practice decisions. Our respondents reported benefits of prior training such as familiarity and ease with the process, as well as a clearer understanding of the purpose of the research. Several equipment related issues were also resolved prior to the backcountry visit. In each case we suspect this lowered the influence or potential of behavioral reactance.

In examining the data generated by thinkalouds it became clear there is a large range of possible cognitive processes that are recognizable and documentable. However, this raises concern that a large number of thinkalouds are required if patterns and trends are going to be identifiable. That is, given the complexity of low-impact decisions each individual thinkaloud captures in-depth

idiographic detail but each thinkaloud is less useful for documenting generalizable, nomothetic patterns of response. It will be a significant research endeavor, indeed, that fully identifies and validates the cognitive processes described throughout this report. However, we urge attention to this task, given the rising numbers of visitors to wildland settings and the importance of low-impact practices in preserving the essential qualities of these locations.

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Appendix A – Annotated Thinkaloud Bibliography

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Presents the "think aloud" method of data collection in descriptive reseach and concludes that this method can be a viable research technique when paired with a suitable means of data analysis. This would involve one that can handle the Ss' verbalizations in a structural manner to elucidate rather than prejudge their immanent sense. Phenomenology provides such a means of structural analysis. Some illustrations of results that were obtained by the use of these procedures are provided. (62 ref) (PsycLIT Database 1985)

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Examined the influence of prior knowledge and text genre on readers' prediction strategies (PSs). Three groups of 5 Ss each read 2 genres of text (short stories and essays) and gave verbal reports of their PSs while reading. Next, Ss rated the texts in terms of relative familiarity of text content. Quantitative analysis of the think-aloud protocols indicated statistically significant differences in frequency of reports of predictions for particular texts. Ss reported making significantly more predictions on the essays rated more familiar and on the story which was rated more familiar. No significant differences appeared in frequency of reported predictions on the short story and essay which were rated most familiar. (PsycLIT Database 1991)

Akita, K., M. Sato, et al. (1991). "/ The growth of teachers' practical knowledge of instruction: Comparison between experts and novices." Japanese Journal of Developmental Psychology **2**(2): 88-98.

Studied the expansion of practical knowledge, with emphasis on cognitive processes in an instruction situation. Human Ss : 10 normal male and female Japanese adults. Five experienced and 5 novice teachers were asked to watch a videotape of a teaching session and to comment on whatever topics came to mind (i.e., think-aloud method). (English abstract) (PsycLIT Database 1993)

Allwood, C. M. (1984). "Error detection processes in statistical problem solving." Cognitive Science **8**(4): 413-437.

Studied problem solvers' error-detection processes by instructing 16 1st-yr statistics students to think aloud when solving 2 statistical problems. The evaluative episodes occurring in Ss' protocols were divided into affirmative evaluation, direct error-hypotheses, error suspicion, and standard check episodes, the last 3 of which are assumed to cover all main types of error-detection processes. Results show that 78% of Ss' errors contributed to a solution part that triggered some evaluative episode; however, only one-third of the undetected errors had contributed to such a solution part. The standard check episodes led to the detection of only a few errors in proportion to the number of times they were performed. Evidence was found for 2 types of spontaneous error detections, one occurrence abruptly and the other as a result of a more elaborated error-detection process that was initiated by the solver perceiving the solution as dissatisfying or strange. The perception of a symptom was a fairly reliable source of information about errors, but Ss often did not detect the error after having noticed a symptom. The closer a relevance error suspicion episode followed an error, the greater was the probability of detecting the error. (12 ref) (PsycLIT Database 1985)

Allwood, C. M. (1990). "On the relation between justification of solution method and correctness of solution in statistical problem solving." Scandinavian Journal of Psychology **31**(3): 181-190.

In Study 1, 16 university students were asked to think aloud while solving 2 statistical problems. An incorrect choice of solution method was more common when Ss did not justify their choice of solution, compared with when they justified their choice with domain-specific knowledge. In Study 2, 20 university students were instructed to provide a justification for each choice of solution method, while another group of 20 Ss received no such instructions. Results show no difference between the groups with respect to number of correct choices of solution method. Justifications for incorrect solution methods in the instructed group were more often incorrect than Ss' justifications for correct solution methods. Results of Study 2 suggest that the association between incorrect choice of solution method and lack of justification in Study 1 was due to a lack of domain-specific knowledge. (PsycLIT Database 1991)

Allwood, C. M. and H. Montgomery (1977). "Detection of errors in statistical problem solving." Goteborg Psychological Reports **7**(9): 28 p.

Asked 10 undergraduates to think aloud while solving 2 statistical problems. Ss were given general instructions on how to proceed in various situations. Some of these instructions asked S, after each substep of problem solving, to check in various ways the solution of the previous substep (the routine control instructions (RCI)). Ss eliminated 25 out of 56 errors when they solved the problems. Nine errors were eliminated when Ss responded to RCI. Another 4 errors were eliminated in response to other control instructions. The think-aloud data indicated that Ss eliminated their own errors by (a) "spontaneous discovery," (b) noticing that computations resulted in extreme values, (c) discontent with other aspects of a solution than the value of an answer, or (d) repeating a solution. The last-mentioned type of error eliminations occurred only when Ss responded to RCI. It was found that Ss often gave unspecific responses to RCI. It is concluded that Ss tended to follow a strategy of minimal cognitive strain when they responded to RCI. (PsycLIT Database 1979)

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Allwood, C. M. and H. Montgomery (1987). "Response selection strategies and realism of confidence judgments." Organizational Behavior and Human Decision Processes **39**(3): 365-383.

A pilot study, in which 6 Ss (aged 25-29 yrs) thought aloud while answering general knowledge questions, was carried out to identify different response selection strategies. In Study 1, 40 Ss responded to the same questions and indicated which of 4 strategies (immediate recognition, inference, intuition, or guessing) they used for selecting an answer. In Study 2, think aloud reports from 20 Ss were coded into the same 4 strategies. The distribution of strategies differed between the studies, but there were similar relations

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among strategy, confidence, and correctness of answer in the 2 studies. When confidence was partialed out, immediate recognition was associated with higher proportion correct than with the other strategies. Ratings of how difficult the knowledge questions were to fellow students of the Ss were more realistic than the confidence ratings. (PsycLIT Database 1987)

Amerge, C. and C. Marine (1992). "Etude comparative expert-debutant lors de l'elaboration d'un prediagnostic ergonomique. / Expertise in ergonomic diagnosis." Travail Humain **55**(2): 97-117.

Compared assessment activities of novice ergonomists and expert ergonomists. Human Ss were 6 normal French adults (university students) (ergonomics majors) amd 6 normal French adults (ergonomists with at least 3 yrs of professional experience). Ss were presented with an ergonomic problem involving a high turnover rate of engineers in an electronics company and asked to think aloud while gathering information and formulating hypotheses concerning this problem. Ss' verbal protocols were analyzed for the numbers and types of data considered and hypotheses formulated, and intergroup differences were determined. (English abstract) (PsycLIT Database 1993)

Audet, R. H. and G. L. Abegg (1996). "Geographic Information Systems: Implications for problem solving." Journal of Research in Science Teaching **33**(1): 21-45.

Compared expert and novice-based problem-solving behaviors with a Geographic Information Systems (GIS) program called ArcView. Five teachers, 5 high school students and 5 GIS experts described their GIS problem-solving strategies during reflective think-aloud sessions. Three GIS problem-solving typologies were identified. Experts relied on logical formulations to query the data base. Among the novices, trial-and-error methods and midlevel cognitive strategies that relied on spatial analyses were most prevalent. As novices progressed through the problem set, higher-level cognitive operations were used more frequently. Findings suggest the importance of additional cognitive studies and classroom evaluations of various instructional models prior to the wholesale introduction of GIS technology into high school classrooms. (PsycLIT Database 1997)

Batra, D. and J. G. Daviss (1992). "Conceptual data modelling in database design: Similarities and differences between expert and novice designers." International Journal of Man Machine Studies **37**(1): 83-101.

Examined the similarities and differences between 5 experts and 4 novices engaged in a conceptual data modeling task, using data gathered in the form of think-aloud protocols. Experts focused on generating a holistic understanding of the problem before developing the conceptual model. They were able to categorize problem descriptions into standard abstractions. Novices tended to have more errors in their solutions, largely due to their inability to integrate the various parts of the problem description and map them into appropriate knowledge structures. Expert and novice behavior was similar in terms of modeling facets like entity, identifier, descriptor and binary relationship, somewhat different in modeling ternary relationship, but quite different in the modeling of unary relationship and category. (PsycLIT Database 1993)

Baumann, J. F., N. Seifert Kessell, et al. (1992). "Effect of think-aloud instruction on elementary students' comprehension monitoring abilities." Journal of Reading Behavior **24**(2): 143-172.

Investigated the effectiveness of explicit instruction in think aloud (TA) as a means to promote 66 4th-grade elementary students' comprehension monitoring abilities. Ss were randomly assigned to 1 of 3 experimental groups: (1) 22 Ss to the TA group, (2) 22 Ss to the directed reading-thinking activity (DRTA) group, and (3) 22 Ss to the directed reading activity (DRA) group, an instructed control. TA and DRTA Ss were more skillful at comprehension monitoring than DRA Ss. Although TA-trained Ss had greater awareness of comprehension monitoring abilities, DRTA Ss' performance equaled or exceeded that of the TA Ss. Both TA and DRTA strategies were effective for enhancing Ss'

comprehension monitoring abilities, but additional research is needed to determine the relative effectiveness of TA and DRTA approaches. (PsycLIT Database 1993)

Beaudichon, J. (1973). "Nature and instrumental function of private speech in problem solving situations." Merrill Palmer Quarterly **19**(2): 117-135.

Divided 34 Ss from 51/2-6 yrs old, and a 2nd group of 44 Ss from 71/2-8 yrs old into 3 subgroups according to 3 experimental conditions: (a) preliminary task followed by 2 easy problems concerned with ordering and selection in 15 min; (b) 2 difficult ordering and completion problems in 20 min; and (c) 2 difficult problems also, but Ss were given instructions to think aloud. Tape-recorded utterances, as information units, were categorized as more or less long-term regulation or recapitulation utterances, immediate regulation utterances, affect-dominated utterances, or incidental verbal activity. Results show that: (a) There is a decrease in the number of utterances produced as a function of age only when the problems to be solved are complex. (b) There is a qualitative change in verbal activity as a function of age. (c) A direct relationship between task difficulty and number of utterances produced exists only at 5 yrs old; at 7 yrs old only a tendency remains. (d) There is a relationship between the nature of utterances produced and performance level. (e) The child is capable of controlling and modifying his verbal production as a function of the instructions given. (23 ref.) (PsycLIT Database 1974)

Berardi Coletta, B., L. S. Buyer, et al. (1995). "Metacognition and problem solving: A process-oriented approach." Journal of Experimental Psychology Learning, Memory, and Cognition **21**(1): 205-223.

Four studies were conducted to demonstrate that the positive effects of verbalization on solution transfer found in previous studies were not due to verbalization per se but to the metacognitive processing involved in the effort required to produce explanation for solution behaviors. In Experiments 1, 2, and 3, a distinction was made between process-oriented, problem-oriented, and simple "think aloud" verbalizations. The process-oriented (metacognitive) solvers performed significantly better than nonprocess control groups on both training and transfer tasks. Experiment 4 further demonstrated this effect by showing that process-oriented participants consistently form more sophisticated problem representations and develop more complex strategies. (PsycLIT Database 1995)

Berger, C. R. and J. M. Jordan (1992). "Planning sources, planning difficulty and verbal fluency." Communication Monographs **59**(2): 130-149.

Examined the sources of knowledge that persons use to devise plans to reach social goals. Specific episodes, ensembles of episodes, hypothetical episodes, role models, instruction, and previous plans were identified as sources. Using a think-aloud procedure, 72 university students were asked to develop plans for reaching the goals of requesting a date, ingratiating one's self to a new roommate, persuading another person on an issue, and becoming a millionaire. Protocols generated by this procedure were analyzed for evidence of the 6 knowledge sources. Speech generated during the think-aloud procedure was subjected to sound-silence analysis. Generalized knowledge sources were more frequently used as a basis for planning for the more familiar goals. However, specific, vivid instances were the most prevalent source of knowledge for developing ingratiation plans. Pausal phenomena were found to be related to the difficulty of generating plans for goals. (PsycLIT Database 1992)

Bettman, J. R., E. J. Johnson, et al. (1993). "Correlation, conflict, and choice." Journal of Experimental Psychology Learning, Memory, and Cognition **19**(4): 931-951.

Examined the degree to which individuals adapt their decision processes to the degree of interattribute correlation and conflict characterizing a decision problem. On the basis of an effort-accuracy framework for adaptive decision making, it was predicted that the more negatively correlated the attribute structure, the more people will use strategies that process much of the relevant information and make trade-offs. A computer simulation study supported these predictions, and 2 experiments using process-tracing techniques to

monitor information acquisition indicated that individuals did indeed respond to interattribute correlation by shifting their processing strategies in ways that are adaptive according to the effort-accuracy framework. In particular, they faced conflict rather than avoided it and generally processed more information, were less selective, and showed more alternative-based processing in negatively correlated environments. (PsycLIT Database 1993)

Billings, R. S. and S. A. Marcus (1983). "Measures of compensatory and noncompensatory models of decision behavior: Process tracing versus policy capturing." Organizational Behavior and Human Performance **31**(3): 331-352.

Examined 2 measures from a search task (the variability and pattern of search on an information board) and 3 measures from a rating or judgment task (nonlinear regression modeling and ANOVA measures of interaction and curvilinearity) in an experiment with 48 undergraduates. The validity of these measures was assessed by their sensitivity to a manipulation of information load and their extent of convergence with one another. The variability of search on the information board and the ANOVA measures of interaction and curvilinearity all indicated an increase in noncompensatory decision making under high information load, while the regression modeling measure did not. There was some convergence between the regression and ANOVA indices, but no relation between the search task and rating task measures. It is concluded that the ANOVA measures of interaction and curvilinearity are more sensitive measures than the nonlinear regression procedure. (28 ref) (PsycLIT Database 1984)

Bisseret, A., C. Figeac Letang, et al. (1988). "Modelisation de raisonnements opportunistes: L'activite des specialistes de regulation des carrefours a feux. (Modeling of "opportunistic" reasoning: The activities of traffic-control experts at intersections during a fire.)." Psychologie Francaise **33**(3): 161-169.

Studied the reasoning processes and activities of traffic-control experts charged with the task of rerouting traffic during an emergency. Focus was on testing the hypothesis that the activity of traffic-control experts is "opportunistic" (i.e., geared to the demands of the immediate situation) rather than based on preconceived rules of action. Human Ss: 6 normal French adults (traffic controllers). Ss were asked to think aloud while designing a plan for controlling traffic at a complex intersection during a fire. Ss' verbalizations, notes, and sketches were analyzed to determine the salient characteristics of their reasoning processes. Results were interpreted via the blackboard model of problem solving. (English abstract) (PsycLIT Database 1992)

Blackwell, R. T., J. P. Galassi, et al. (1985). "Are cognitive assessment methods equal? A comparison of think aloud and thought listing." Cognitive Therapy and Research **9**(4): 399-413.

Investigated the extent to which think-aloud and thought-listing cognitive assessment methods would generate comparable data in the mathematical problem solving of 64 highly math-anxious undergraduates. Ss completed 2 sets of mathematics problems. During one set they thought aloud while problem solving, and during the other they listed their cognitions after completing each problem. Assessment-method and problem-set orders were counterbalanced in a split-plot design. Dependent variables included 11 cognitive content variables, subjective anxiety, number of problems correct, and amount of time for each set-assessment phase. Ss were significantly more anxious and took longer to list thoughts than to think aloud. Differences on number of problems correct approached significance. On the average, think aloud produced twice as many thoughts as thought listing and significantly more thoughts in 4 categories: review of information, strategic calculations, conclusions, and attention control. Thought listing produced significantly more positive problem-solving evaluations and more positive self-evaluations. An analysis of proportions revealed the same differences plus a significantly greater proportion of thoughts in 5 other categories for thought listing. (29 ref) (PsycLIT Database 1986)

Bock, H. (1987). "Die Interpretation von "Semantischen Anomalien" durch Modifikation von mnestisch stabilen Bezugssystemen. / The interpretation of "semantic anomalies" by the modification of mnestically stabilized frames of reference." Psychologische Beitrage **29**(4): 690-708.

Studied the processes involved in assigning meaning to word combinations that deviate from conventional semantic reference systems. Human subjects: 19 normal German adults. The Ss were asked to think aloud while exploring the possible meanings of 4 semantic anomalies (e.g., "a growing stone") and to provide further information on their thought processes and experiences during this task. The transcripts were analyzed to determine the processes and principles involved in resolving semantic inconsistencies. This is 1 article in a series (1987). (English, French & Japanese abstracts) (PsycLIT Database 1990)

Bockenholt, U., D. Albert, et al. (1991). "The effects of attractiveness, dominance, and attribute differences on information acquisition in multiattribute binary choice." Organizational Behavior and Human Decision Processes **49**(2): 258-281.

Two process tracing studies using 34 college students, investigated how the information acquisition process in a binary choice task is influenced by the overall level of attractiveness of alternatives, by the magnitude of differences in attractiveness of alternatives, and by the dominance of one alternative. All 3 factors influenced the Ss' information selection process regarding the multi-attribute choice alternative. Ss selected more information when the attractiveness difference was small and when one of the alternatives was not dominant. Moreover, they considered more information when the choice alternatives were both unattractive. These findings were obtained when information was presented about the alternatives both numerically and nonnumerically. (PsycLIT Database 1992)

Bockenholt, U. and L. S. Hynan (1994). "Caveats on a process-tracing measure and a remedy." Journal of Behavioral Decision Making **7**(2): 103-117.

In process-tracing studies, a frequently used index describes whether information selection behavior is attribute- or alternative-wise. This article presents an analytic treatment which illuminates the index's strengths and limitations. Conditions are discussed under which the index may be inaccurate in identifying a particular information strategy or in detecting a strategy change between or within experimental conditions. An alternative measure is derived that may prove more sensitive in distinguishing between alternative and attribute-wise information-acquisition patterns. A general approach is provided for the treatment of individual differences in the analysis of information selection strategies. By introducing a latent-class model that locates distinct subgroups in the data, a straightforward solution is presented to the problem of how to interpret effects of task conditions in the presence of systematic individual differences. (PsycLIT Database 1994)

Bond, J. A. and H. A. Buchtel (1984). "Comparison of the Wisconsin Card Sorting Test and the Halstead Category Test." Journal of Clinical Psychology **40**(5): 1251-1255.

Argues that M. G. Pendleton and R. K. Heaton's (see PA, Vol 68:2532) correlational comparisons of the Wisconsin Card Sorting Test and the Halstead Category Test are inadequate to assess the degree to which these 2 tests call upon the same cognitive processes. Asking patients to "think aloud" while performing on the tests is recommended as a more direct approach to understanding the cognitive components of the tests. Some results of analysis of such think-aloud protocols are presented that suggest the differences and areas of overlap of the 2 tests. (12 ref) (PsycLIT Database 1985)

Boreham, N. C. (1986). "A model of efficiency in diagnostic problem solving: Implications for the education of diagnosticians." Instructional Science **15**(3): 191-211.

Describes a model of the efficient diagnosis of a simulated performance problem. The model was developed by analyzing think-aloud protocols elicited from 3 management consultants, chosen because of their experience and expertise in organizational problem

solving. Source models including rule-based and knowledge-based models were used to develop a bounded rationality model. The general pattern of the model is an alternation between concept-driven restructuring of a mental model of the situation, and sensory-driven search through the problem givens. Implications of the model are discussed in terms of the nature of efficiency in diagnostic reasoning, the human factors required for successful diagnosis, and the process of planning. (PsycLIT Database 1988)

Boreham, N. C., R. W. Foster, et al. (1992). "Strategies and knowledge in the control of the symptoms of a chronic illness." Travail Humain **55**(1): 15-34.

Conducted research into how doctors adjust doses of a drug for the suppression of epileptic seizures. Although the theoretical model that explains the effect of dose adjustments on steady-state plasma concentration implies a backward reasoning strategy (i.e., first selecting a target plasma concentration and then inferring from the model which dose will produce this in the patient), results of process-tracing studies indicate that only the least expert Ss attempt the task in this way. Experts follow a forward reasoning strategy comprising 3 operations: primary monitoring, rule-based inferencing, and secondary monitoring. Primary monitoring asks whether the patient's seizures justify an increment in daily dose; rule-based inferencing suggests which particular increment would be appropriate; and secondary monitoring examines the proposed new dose for contraindications. Case material and excerpts from the protocols are appended. (French abstract) (PsycLIT Database 1993)

Boreham, N. C., G. E. Mawer, et al. (1996). "Medical diagnosis from circumstantial evidence." Travail Humain **59**(1): 69-85.

Proposes a model of diagnostic reasoning from a combination of circumstantial and direct evidence, using developments in the logic of abduction and J. Reason's (1990) design for a fallible machine. The model was tested against data from a process-tracing study of the diagnostic reasoning of 32 final-year medical students. Analyzing their think-aloud protocols in terms of abductive logic successfully differentiated patterns of thinking that produced correct and incorrect diagnoses: although all Ss constructed coherent causal accounts of case details, Ss who made incorrect diagnoses used incorrect scientific beliefs to do so. The incorrect scientific beliefs were overgeneralizations of true scientific principles. The tendency to make these mistakes is attributed to the emphasis on biomedical (vs social) explanations of patients' symptoms in medical school. (French abstract) (PsycLIT Database 1997)

Borko, H. and J. A. Niles (1983). "Teachers' cognitive processes in the formation of reading groups." National Reading Conference Yearbook **32**(282-288).

Descriptions of 32 hypothetical 2nd-grade students were presented to 4 experienced and 4 student teachers who were asked (1) to make judgments about each concerning competence and impact on classroom life and (2) to place the students in reading groups. Ss were asked to think aloud while performing the experimental tasks. The case studies of an experienced and a student teacher are presented to illustrate the findings. Ss' judgments and decisions were strongly influenced by general themes or value positions and by the hierarchical nature of their decision strategies. Although each S stated her initial management decision, neither could articulate rules lower in the decision hierarchy. (PsycLIT Database 1987)

Boshuizen, H. P. and H. G. Schmidt (1992). "On the role of biomedical knowledge in clinical reasoning by experts, intermediates and novices." Cognitive Science **16**(2): 153-184.

In Exp 1, 4 Ss at different levels of medical expertise thought aloud while diagnosing a case. Results demonstrate a decrease in the use of biomedical knowledge with increasing expertise. In Exp 2, 3 possible explanations were investigated: (1) rudimentation of biomedical knowledge, (2) inertia, and (3) encapsulation of biomedical knowledge under higher order concepts. Using a think-aloud and post-hoc explanation methodology with 20

Ss at different levels of medical expertise, it was shown that experts have more in-depth biomedical knowledge than novices and Ss at intermediate expertise levels. Findings generally support a 3-stage model of expertise development in medicine consisting of acquisition of biomedical knowledge, practical experience, and integration of theoretical and experiential knowledge resulting in knowledge encapsulation. (PsycLIT Database 1993)

Bostrom, A., C. J. Atman, et al. (1994). "Evaluating risk communications: Completing and correcting mental models of hazardous processes: II." Risk Analysis **14**(5): 789-798.

Proposes a decision-analytic framework, called the mental models approach, for evaluating the impact of risk communications. The approach uses multiple evaluation methods, including think-aloud protocol analysis, problem solving, and a true-false test that allows respondents to express uncertainty about their answers. The approach is illustrated with 108 Ss in 2 empirical comparisons of 3 brochures about indoor radon. One brochure used an influence diagram and 1 used a decision tree to address risk associated with radon; the 3rd was the brochure distributed by the US Environmental Protection Agency (EPA). The 1st 2 brochures outperformed the EPA brochure in filling knowledge gaps, contradicting misconceptions, and enabling Ss to solve problems about radon. The EPA text was most confusing to Ss. (PsycLIT Database 1995)

Bree, D. S. (1975). "Understanding of structured problem solutions." Instructional Science **3**(4): 327-350.

Investigated how much structured material (e.g., sample solutions to problems) is understood, what is earmarked for storage, what remains stored, and how useful this is for recreating the problem's solution. Based on the assumption that "understanding" is the result of a cognitive process in which information about the material is stored in memory, 12 university students were required to think aloud as they were given 3 problem solutions-the solution of the "missionaries and cannibals" problem, a geometry proof, and a plan for another geometry proof. Each solution was presented step-by-step; immediately after understanding the solution, S was asked to recall the major points in the solution. One week later, Ss were asked to repeat these steps and reproduce the solution. Results suggest that the understanding process has some consistency across different tasks and that the kinds of points best retained were the context of the problem and subproblems within the solution. The importance of S's method for deciding when he understands is discussed. (20 ref) (PsycLIT Database 1975)

Bridge, C. A. and P. N. Winograd (1982). "Readers' awareness of cohesive relationships during cloze comprehension." Journal of Reading Behavior **14**(3): 299-312.

20 9th-grade good and poor readers (the Comprehensive Test of Basic Skills) completed a cloze passage in which words involved in 3 kinds of cohesive relationships--referential, conjunction, and lexical--had been systematically deleted. Ss were asked to read the passage orally, supply the missing words, and think aloud about the reasons for supplying each cloze deletion. Results indicate that Ss were aware of the cohesive relationships in text and that they generally used these relationships to help them supply the missing cloze items. More importantly, Ss varied their use of intrasentential and intersentential information based on the type of cohesion involved in the cloze. Results are discussed in terms of the debate over whether cloze is sensitive to intersentential processing and the use of cloze as an instructional technique in the classroom. (22 ref) (PsycLIT Database 1985)

Buehler, R., D. Griffin, et al. (1994). "Exploring the "planning fallacy": Why people underestimate their task completion times." Journal of Personality and Social Psychology **67**(3): 366-381.

Tested 3 hypotheses concerning people's predictions of task completion times: (1) people underestimate their own but not others' completion times, (2) people focus on plan-based scenarios rather than on relevant past experiences while generating their

predictions, and (3) people's attributions diminish the relevance of past experiences. Five studies were conducted with a total of 465 undergraduates. Results support each hypothesis. Ss' predictions of their completion times were too optimistic for a variety of academic and nonacademic tasks. Think-aloud procedures revealed that Ss focused primarily on future scenarios when predicting their completion times. The optimistic bias was eliminated for Ss instructed to connect relevant past experiences with their predictions. Ss attributed their past prediction failures to external, transient, and specific factors. Observer Ss overestimated others' completion times and made greater use of relevant past experiences. (PsycLIT Database 1995)

Burgoyne, J. G. (1975). "The judgement process in management students' evaluation of their learning experiences." Human Relations **28**(6): 543-569.

Investigated the process of judgment underlying the formation of evaluative opinions by 6 management development program participants. The methodology of protocol analysis was employed. This involved an inductive analysis of the content of recordings made when a person is asked to "think aloud" while making a decision. Results show that many of the features of valid judgment (e.g., the use of objectifiable criteria and control-group logic) are present, to some extent, in the judgment process underlying evaluative opinions. This suggests that a certain amount of validity can be attached to opinion-based follow-up studies and that there is the possibility of designing such studies to encourage these processes. (PsycLIT Database 1976)

Butcher, E. and M. E. Scofield (1984). "The use of a standardized simulation and process tracing for studying clinical problem-solving competence." Counselor Education and Supervision **24**(1): 70-84.

Examined the clinical judgment and problem-solving processes used by counselors and psychologists to develop a working knowledge of how competent practitioners function. A standardized treatment planning simulation and a process tracing strategy were used to qualitatively examine how 9 male and 6 female mental health clinicians (aged 23-40 yrs) solved a typical client-management problem. Data show that 80% of the Ss used descriptive rather than formal diagnostic terms to identify client problems. Males noted more diagnostic impressions than females and Ss working in agency or hospital settings considered more diagnostic impressions than Ss in school or private practice. Three patterns characterized information searches: finding a diagnosis, confirming an initial diagnostic impression formed almost immediately in the inquiry process, and an interdisciplinary review of the case and its progress. Generally, females conducted more thorough case reviews and considered more perspectives in problem solving, while males relied more on personal experience and independent decision making. The influence of training and experience on problem-solving strategies and implications for training and assessment of mental health professionals are discussed. (19 ref) (PsycLIT Database 1985)

Chambliss, M. J. (1995). "Text cues and strategies successful readers use to construct the gist of lengthy written arguments." Reading Research Quarterly **30**(4): 778-807.

Conducted 3 experiments, one for each stage in the argument comprehension model. 80 12th-grade advanced placement English students read arguments varying in argument structure, content familiarity, and argument signaling and completed either written survey or think-aloud protocol comprehension tasks. Both text structure and signaling in introductions and conclusions consistently influenced their responses. Students used these cues to recognize the argument structure in a lengthy text, identify the claim and evidence, and construct a gist representation. Outcomes have both general theoretical value and practical implications for designing instructional materials. Students' performance was consistent across 14 separate argument topics, 2 types of tasks and analyses, and 3 data collection sessions. Results also suggested use of specific text cues and strategies. (Spanish, German, Japanese & French abstracts) (PsycLIT Database 1996)

Chan, C., J. Burtis, et al. (1997). "Knowledge building as a mediator of conflict in conceptual change." Cognition and Instruction **15**(1): 1-40.

Examined how individuals and peers process scientific information that contradicts what they believe and assessed the contribution of this activity to conceptual change (CPC). 54 9th graders and 54 12-13th graders were randomly assigned to 1 of 4 conditions: (1) individual and (2) peer conflicts, and (3) individual and (4) peer assimilations (ASNs). Depending on the condition, Ss were asked to think aloud or discuss with their peers 8 scientifically valid statements, which were presented in an order that either maximized or minimized the conflict between new information and existing beliefs. Two major approaches were identified: direct ASN and knowledge building (KB). A path analysis showed that the level of knowledge-processing activity had a direct effect on CPC and that this activity mediated the effect of conflict. KB as a mediator of conflict in CPC helps to explicate previous equivocal research findings and highlights the importance of students' constructive activity in learning. (PsycLIT Database 1997)

Chan, C. K., P. J. Burtis, et al. (1992). "Constructive activity in learning from text." American Educational Research Journal **29**(1): 97-118.

Examined children's integration of new information when they are learning from text. Informative statements were read to 109 1st-6th graders who were asked to think aloud about each statement. Analysis of the protocols led to a scale identifying 5 levels of constructive activity with 3 subtypes at each level. The 5 levels were prefactual confabulation, knowledge/detail retelling, assimilation, problem solving, and extrapolation. The 3 subtypes were declarative, interrogative, and evaluative responses. Measures of prior knowledge and new learning were also obtained. A path analysis suggested that the level of activity identified by the scale exerted a direct effect on learning and mediated the effects of age and prior knowledge on learning. (PsycLIT Database 1992)

Charness, N. (1981). "Search in chess: Age and skill differences." Journal of Experimental Psychology Human Perception and Performance **7**(2): 467-476.

34 chess players 16-64 yrs old varying in skill generated think-aloud protocols for each of 4 chess positions. Findings indicate that (a) more skilled players search more extensively and deeply; (b) older players search less extensively, though equally deeply; (c) rate of search did not generally vary with age or skill; and (d) the quality of the selected move varied only with skill. Results suggest that the ability to remember changes in piece positions and the ability to evaluate positions reached in search differs with skill level. (23 ref) (PsycLIT Database 1982)

Chinien, C. A. and F. Boutin (1992). "Cognitive style FD/FI as a learner selection criterion in formative evaluation: A qualitative analysis." Performance Improvement Quarterly **5**(2): 24-33.

A qualitative study demonstrated the effectiveness of the cognitive style construct field-dependent/independent (FD/FIN) as a student selection criterion for single-S formative evaluations. Formative evaluation data were obtained from 2 FD and 2 FIN college students while they were individually interacting with a computer-assisted instructional package. The 4 sources of data were think-aloud protocols, researcher-S interactions, informal observations, and debriefing interviews. Analysis indicates that the FIN Ss were better test Ss than their FD counterparts. FIN Ss showed a great deal of confidence in the evaluation process, their feedback was abundant and precise, and they speculated about difficulties. FD Ss were anxious and demonstrated less confidence; their feedback data were vague. Both FD and FIN Ss could identify major discrepancies in the presentation of the material. (PsycLIT Database 1992)

Chwalisz, K., N. Wiersma, et al. (1996). "A quasi-qualitative investigation of strategies used in qualitative categorization." Journal of Counseling Psychology **43**(4): 502-509.

This study investigates how analysts approach the task of initially categorizing qualitative data, what analysis strategies increase or decrease the testimonial validity of the categories, whether the data should be presented as a whole or in meaningful units, the effects of analysts' familiarity with the material, and the cognitive strategies associated with testimonial validity judgments. 30 upper level undergraduates (aged 19-42 yrs) analyzed essay data for "themes" while engaged in a think-aloud task. The essay writers then ranked the sets of categories in terms of overall quality and rated them on dimensions relevant to testimonial validity while thinking aloud. Think-aloud protocols for the best and worst approaches are examined. Implications for the use of qualitative research methods are discussed. (PsycLIT Database 1997)

Coleman, E. B. and B. M. Shore (1991). "Problem-solving processes of high and average performers in physics." Journal for the Education of the Gifted **14**(4): 366-379.

Examined cognitive processing differences reported between 21 high school physics students to compare corresponding processes in high and average school achievers as determined by performance measures and a teacher referral. Ss were asked to think aloud while solving 5 physics problems. High achievers made more correct metastatements and more references to prior knowledge than did the average achievers, thus indicating similarities between high performance (i.e., giftedness) at the high school level and expertise in physics. Data illustrate the importance of metacognition in supporting the assertion that gifted students think qualitatively differently. Findings also indicate that the use of prior knowledge is a variable on which gifted students may solve problems in ways similar to those of experts. (PsycLIT Database 1992)

Colley, A., L. Banton, et al. (1992). "An expert-novice comparison in musical composition." Psychology of Music **20**(2): 124-137.

One male expert composer and 3 female undergraduate novice composers were given a 4 phrase chorale with half of the 1st phrase and the soprano line provided. Ss were required to complete as much of the chorale as possible within 1 hr. Think-aloud protocols were recorded, and retrospective interviews were conducted. Only the expert completed the task. He was able to attend to the basic technical aspects of the task and to simultaneously consider part movement, balance, and typical features of the genre. Novices concentrated on chord-by-chord solutions, applied the basic rules of harmony, and largely neglected the shape and balance of the emerging score. The comparison of the protocols from the expert and novices provided evidence of characteristics of expertise found in problem-solving tasks in other domains. (PsycLIT Database 1993)

Collins, K., M. Luszcz, et al. (1997). "Everyday problem solving in elderly women: Contributions of residence, perceived control, and age." Gerontologist **37**(3): 293-302.

Examined the use of relativistic operations in everyday problem solving by 32 female community residents and 32 female nursing hostel residents (aged 65-90 yrs) via think-aloud procedures to assess problem-solving tactics. Path analysis was used to test the developed model of the influences of age, engagement in problem-solving activities, control orientation, problem familiarity, and residence on the use of relativistic operations. Partial support was found for the proposed model. Community Ss used significantly more relativistic operations to solve the problems than did hostel Ss. A revised model showed that in addition to residence and control orientation, the use of relativistic operations was influenced indirectly by the level of everyday problem-solving activity, through the orientation of perceived control. Increased problem-solving activity was associated with an internal control orientation, which in turn was directly related to the use of relativistic operations. The influence of age on problem solving was indirect, through problem-solving activity and residence. (PsycLIT Database 1997)

Conway, M., A. Howell, et al. (1991). "Dysphoria and thought suppression." Cognitive Therapy and Research **15**(2): 153-166.

Addressed dysphoric individuals' suppression of unwanted thoughts in 2 studies. In Study 1, 21 dysphoric and 21 nondysphoric undergraduates were given either success or failure feedback on a test. They were then asked not to think of this test while completing a 5-min think-aloud procedure. In line with the mood-congruence hypothesis, dysphoric Ss had more intrusions of failure and fewer intrusions of success than nondysphoric Ss. In line with the cognitive-effort hypothesis, dysphoric Ss in both feedback conditions exhibited more intrusions in the 5th, final min of the think-aloud period. In Study 2, 31 dysphoric and 28 nondysphoric Ss were instructed not to think of the neutral target white bear. Again, dysphoric relative to nondysphoric Ss exhibited more intrusions in the 5th, final min of the think-aloud period. (PsycLIT Database 1991)

Corbeil, G. (1992). "Differences de demarches d'apprentissage de grammaire entre des etudiants forts et faibles de francais langue seconde. (Differences in approaches to learning grammar by strong and weak students of French as a second language.)." Canadian Journal of Education **17**(4): 437-448.

Studied approaches to learning grammar by English-speaking university students with high or low achievement in a course on French grammar. Ss were 2 high-achievement and 3 low-achievement university students. Ss were asked to think aloud while working on a series of translations from English to French. Intergroup differences in attitudes toward the task and in the number and types of strategies (e.g., self-correction, textbook consultation, etc) used to perform the translations were analyzed. (English abstract) (PsycLIT Database 1994)

Cordon, L. A. and J. D. Day (1996). "Strategy use on standardized reading comprehension tests." Journal of Educational Psychology **88**(2): 288-295.

Strategy use and its impact on standardized reading test performance were investigated. High school students were randomly assigned to 2 groups, standardized test and main idea, with separate control and think-aloud conditions. In the standardized think-aloud group, students thought aloud while taking a portion of a reading test, consisting of passages accompanied by several questions each. In the main idea conditions, students read the same passages with the lower level questions removed and answered a single multiple-choice question about the main idea of each passage, having been told that the task was not a test. Both groups used strategies, and students in the standardized test condition made significantly greater use of strategies than students in the main idea condition. Significant between-group differences were found in use of rereading. In comparisons between the think-aloud and control conditions, thinking aloud was found to have a significant detrimental effect on students' ability to identify passage main ideas. (PsycLIT Database 1996)

Cummings, A. L. and K. Curtis (1992). "Social problem solving cognitions and strategies of student teachers." Alberta Journal of Educational Research **38**(4): 255-268.

Investigated the social problem solving of 29 student teachers, using a think-aloud methodology. Ss were asked to solve 4 problems that student teachers typically face (instruction, discipline, supervising teacher, and time demands). Ss gave solutions to the problems at the beginning, middle, and end of their preservice year. Problem solutions were analyzed for 8 different problem-solving elements. Content analysis of the individual strategies indicated that both the type of problem-solving cognitive elements and problem-solving strategies were influenced by the type of problem being solved. There were also changes in the problem-solving elements over time. On all 4 problems combined, there was a decrease in analysis and number of strategies and an increase in evaluation of strategies. (French abstract) (PsycLIT Database 1993)

Dahlstrand, U. and H. Montgomery (1984). "Information search and evaluative processes in decision making: A computer based process tracing study. Ninth Research Conference on Subjective Probability, Utility and Decision Making: Research perspectives on decision

making under uncertainty: Basic theory, methodology, risk and applications (1983, Groningen, Netherlands)." Acta Psychologica **56**(1-3): 113-123.

26 20-40 yr olds chose among 5 flats by interacting with a computer, rated the attractiveness of each piece of information requested from the computer, and rated how eligible each alternative was at regular intervals to investigate Ss' information search and evaluative processes in decision making. Results support the assumption that decision making involves a search for a dominance structure, in which one alternative is seen as dominant over the others. Ss enhanced their attention to and evaluation of the finally chosen alternative long before the actual choice. (5 ref) (PsycLIT Database 1985)

Darken, R. P. and J. L. Sibert (1996). "Navigating large virtual spaces." International Journal of Human Computer Interaction **8**(1): 49-71.

Investigated 6 wayfinding design principles by measuring performance on wayfinding tasks (WTs) in virtual world treatments that provided no assistance (control condition) or assistance in the form of adherence to organizational principles (grid conditions), map principles, or both. Ss were 10 adults (aged 20-45 yrs). The sequencing of the 4 treatments was randomized among Ss. The WTs for all treatments required Ss to use 5 naive searches followed by one primed search. Ss were asked to "think aloud" so their search strategies could be analyzed. Results show that navigational performance was superior under both map treatments compared to control and grid conditions. The grid provided superior directional information compared to other conditions. The control condition provided the worst performance with Ss often becoming disoriented and having difficulty completing the tasks. (PsycLIT Database 1997)

Dautermann, M., K. Schneider, et al. (1988). "Aufgabenbezogene und ichbezogene Kognitionen bei Kindern in Abhangigkeit von Prufungsangst und situativen Bedingungen. (The effects of test anxiety and situational factors on children's task-related and ego-related cognitions.)." Zeitschrift fur Differentielle und Diagnostische Psychologie **9**(1): 1-12.

Studied the effects of gender, test anxiety, and task- vs ego-related orientation on children's cognitions and nonverbal indicators of emotionality in a test situation. Human subjects: 40 normal male and female West German children (8-10 yrs) (elementary school students). The Ss were divided into 2 experimental groups representing task orientation vs ego orientation (induced by the experimenter's verbal instructions), and asked to think aloud while working on a series of anagrams. Content analysis of the thinking-aloud verbalizations was used to differentiate between task-related and self-related cognitions during the task, and behavioral observation provided data on nonverbal indicators of emotionality. Differences in cognitions and performance of the task were analyzed in relation to Ss' gender, task vs ego orientation, and level of test anxiety. Tests used: The Anxiety Questionnaire for Students by W. Wieczerkowski et al (1973). (PsycLIT Database 1990)

Davis, J. N. and L. Bistodeau (1993). "How do L1 and L2 reading differ? Evidence from thinking aloud protocols." Modern Language Journal **77**(4): 459-472.

Determined if reading strategy differed for one's native language (L1) as opposed to the nonnative language (L2). Eight undergraduate native readers of English (NRE) and 8 graduate students who were native readers of French were asked to think aloud as they read 2 different texts, 1 in their L1 and the other in their L2. Ss then wrote a recall protocol in their L1 based on what they remembered. Ss were observed to use 13 strategy categories (e.g., individual word focus, intrasentential features). Results from NRE protocols show greater frequency of bottom-up strategies during L2 reading. An affective difference was also noted in L1 and L2 reading. (PsycLIT Database 1994)

Davison, G. C., S. G. Navarre, et al. (1995). "The articulated thoughts in simulated situations paradigm: A think-aloud approach to cognitive assessment." Current Directions in Psychological Science **4**(1): 29-33.

Describes the Articulated Thoughts in Simulated Situations (ATSS) think-aloud paradigm that facilitates valid cognitive assessment while benefitting from the advantages of think-aloud methodology and minimizing the potential problems. In ATSS, Ss listen to scenarios, then speak their thoughts out loud. ATSS has the advantage of constraining Ss to the data they provide, the degree to which their reports are retrospective, the control of situations in which cognitions of interest are likely to occur, and the flexibility of the approach in studying a broad range of cognitions. ATSS has been used to study cognitive factors in depression, hypertension, speech and social anxiety, smoking relapse, family conflict, and childhood aggression. It is suitable for use with children, younger and older adults, depressed Ss, and populations with limited reading and writing skills. It has face, concurrent, predictive, and construct validity. (PsycLIT Database 1995)

de Mesquita, P. B. (1992). "Diagnostic problem solving of school psychologists: Scientific method or guesswork?" Journal of School Psychology **30**(3): 269-291.

Investigated the diagnostic problem solving of school psychologists through the use of a computer simulation of a typical school referral problem and a verbal retrospective think-aloud protocol. 125 Ss were divided among 3 practitioner and 2 student groups, representing various levels of education and experience. Results suggest that education and experience were unrelated to diagnostic performance generally and diagnostic accuracy specifically. Experienced professionals and less experienced trainees were more alike than different in their diagnostic problem-solving process. Practitioners were significantly more efficient in their processing of diagnostic information than were students. (PsycLIT Database 1992)

de Mul, S. and H. van Oostendorp (1996). "Learning user interfaces by exploration." Acta Psychologica **91**(3): 325-344.

Examined the ability of 99 university students to learn how to use a computer system by exploration and assessed the efficacy of a user interface with facilities that support exploration. In Exp 1, Ss were able to learn to use an electronic mail application that was unknown to them. Ss' knowledge about the interface rose to a high level in an early stage of the experiment. Exp 2 did not show a significant advantage of the interface with the exploration-supportive facilities (ESFs) compared with a version of the interface from which ESFs were removed or replaced by a paper user guide. In Exp 3, using a think-aloud method, the interface with ESFs resulted in a more successful discovery and understanding of several system functions, a better task performance in the 2nd half of the series of tasks, and a better procedural knowledge about the interface. No effects of learning style were found. (PsycLIT Database 1997)

Desforges, C. and S. Bristow (1995). "Academic subjects and pupils' constructive learning processes in the primary school." British Journal of Educational Psychology **65**(4): 465-475.

Examined the assumption that different academic subjects are associated with different forms of constructive activity in regard to young learners. 48 7-11 yr olds were presented with learning materials in the domains of English, mathematics and science, and then required to provide verbal protocols of their intellectual engagements with the experiences. The protocol data were analyzed using a scale of constructive activity the categories of which had been grounded in think-aloud responses. No differences were found in levels of constructive activity between the academic subjects. Each subject was associated with low levels of intellectual engagement. The behavior of the pupils was consistent with C. Bereiter's (see record 78:16862) theory of the operation of a "school work module." (PsycLIT Database 1996)

Devine, D. J. and S. W. J. Kozlowski (1995). "Domain-specific knowledge and task characteristics in decision making." Organizational Behavior and Human Decision Processes **64**(3): 294-306.

Used a process-tracing approach to examine ways in which 2 task characteristics (decision structure and descriptive labeling) affect the amount and type of information that high domain knowledge (HDK) Ss and low domain knowledge (LDK) Ss use to make decisions. Ss were 62 HDK and 61 LDK psychology students with respect to basketball knowledge. Using a computerized information board, the authors found that both task characteristics interacted with knowledge level to affect information acquisition and decision accuracy. HDK Ss were significantly more accurate than LDK Ss on well-structured decisions but not on ill-structured decisions. HDK Ss (1) reduced information search when decisions were well-structured and when alternatives were descriptively labeled and (2) acquired considerably more contextual information than did LDK Ss across all conditions. LDK information acquisition appeared to be unaffected by decision structure or descriptive labeling. (PsycLIT Database 1996)

Dhar, R. and S. J. Sherman (1996). "The effect of common and unique features in consumer choice." Journal of Consumer Research **23**(3): 193-203.

Proposes that the attractiveness of the choice set can be enhanced or reduced by altering which features appear unique. Study 1 assessed 290 adults' preferences for a no-choice option vs choosing between pairs of alternatives that had either shared bad features and unique good features (unique good pairs) or unique bad features and shared good features (unique bad pairs). As predicted, most Ss chose an alternative when there were unique good pairs. Study 2 allowed Ss to switch from their initial choice to a new alternative with both unique good and unique bad features. The likelihood of switching to a new alternative was greater for Ss who made the initial choice from unique bad pairs. A 3rd study used the choice context to increase the attractiveness of a specific alternative by making its good features appear unique, and a 4th study used think-aloud protocols to gain insights into the underlying mechanism. (PsycLIT Database 1997)

Dhar, R. and I. Simonson (1992). "The effect of the focus of comparison on consumer preferences." Journal of Marketing Research **29**(4): 430-440.

Proposes that the attractiveness and choice probability of an alternative can be enhanced by making it the focus of a comparison (the focal option) with a competing alternative. This proposition is supported in choice problems involving alternatives (e.g., frozen yogurt, fruit salad) about which consumers have information in memory. The focal option was manipulated in 5 studies by asking 625 undergraduates how much more or less attractive 1 of the 2 alternatives was. When descriptors of alternatives' features were provided rather than retrieved from memory, a manipulation of the focal option had a weaker and less consistent effect on preferences. Think-aloud protocols were used to gain insights into the effect of changing the focal option on decision processes. (PsycLIT Database 1993)

Dillon, R. F. (1985). "Eye movement analysis of information processing under different testing conditions." Contemporary Educational Psychology **10**(4): 387-395.

Collected eye-movement data during 19 undergraduates' responses to 15 items taken from the Raven Advanced Progressive Matrices. The 15 figural analogies, chosen to sample the range of item difficulty contained in the test, were given under the following conditions: (1) Following an S's reported solution to each item, the experimenter directed questions to the S concerning salient task features (elaborated feedback). (2) The S was asked to think aloud during the problem solution, describing stimulus elements scanned as well as underlying thought processes (verbalization during item solution). (3) Test items were administered according to established procedures. No feedback was provided nor was interaction with the S elicited (standard condition). ANOVA indicated that the percentage of fixations devoted to rule application activities differed as a function of method of test administration: Ss tested under the standard procedure executed a smaller percentage of their fixations during rule application than Ss tested under the elaborative feedback or verbalization conditions. Findings support the premise that enhanced feedback mechanisms and opportunities for dual coding of figural stimulus information

result in the allocation of an increased percentage of information-processing resources to rule application activities. (24 ref) (PsycLIT Database 1986)

Eifert, G. H. and W. Lauterbach (1987). "Relationship between overt behavior to a fear stimulus and self-verbalizations measured by different assessment strategies." Cognitive Therapy and Research **11**(2): 169-183.

Examined the interrelationships between types of self-verbalization (SV) and approach/avoidance behavior in a standard behavior test involving a harmless snake. In addition, to compare 3 common assessment strategies for SV, all 32 Ss (aged 16-54 yrs) were assessed with a think-aloud technique, a videotape reconstruction, and a 24-item SV questionnaire. The think-aloud technique was more reliable and less time-consuming than the other 2 techniques. Affective tone and attentional focus of SV were significantly correlated with the degree of overt approach behavior. Results suggest that the successful completion of a potentially anxiety-inducing task is associated not so much with an absence of negative SV but with the availability of positive SV, to compete with existing negative statements. (PsycLIT Database 1987)

Einhorn, H. J., D. N. Kleinmuntz, et al. (1979). "Linear regression and process-tracing models of judgment." Psychological Review **86**(5): 465-485.

The process of vicarious functioning, by which equivalent judgments can result from different patterns of cues, is central to any theory of judgment. It is argued that both linear regression and process-tracing models capture the various aspects of vicarious functioning: the former by dealing with the ambiguities that the organism faces with regard to the substitutions and trade-offs between cues in a redundant environment, and the latter by dealing with cue search and attention. Furthermore, although the surface structures and levels of detail of the 2 models are different, it is shown that process-tracing protocols can be generated via a general additive rule. Therefore, both types of models can be capturing the same underlying process, although at different levels of generality. Two experiments in which both models are built and tested on the same data are presented. In Exp I, experienced MMPI users made diagnostic judgments of the degree of adjustment/maladjustment from MMPI profiles; in Exp II, 1 S evaluated the nutritional quality of breakfast cereals. Results are discussed with respect to (a) links between judgment, choice, and task structure; (b) rule generality and awareness; and (c) advantages of a multimethod approach. (74 ref) (PsycLIT Database 1980)

Erber, R. and S. T. Fiske (1984). "Outcome dependency and attention to inconsistent information." Journal of Personality and Social Psychology **47**(4): 709-726.

Hypothesized that people sometimes ignore information inconsistent with their expectations, but that outcome dependency (OCD) would increase people's attention to inconsistent information. When the perceiver's outcomes depend on the other person, the perceiver may be more motivated to have a sense of prediction and control, rather than only motivated to maintain the expectation. Attention to inconsistent information potentially increases the perceiver's sense of prediction and control, so it should increase under OCD. Attention to consistent information should be relatively unaffected by OCD. The results of 2 studies with 102 undergraduates support these hypotheses. OCD increased attention to inconsistent information, but did not influence attention to consistent information. In the 2nd study, think-aloud protocols revealed that outcome-dependent Ss made more dispositional comments while attending to inconsistent information, and generated both facilitative and inhibitory dispositional attributions for the inconsistent information. This suggests that whether they integrated the inconsistency or not, they responded with more thought about the other person's stable characteristics. Findings are considered in relation to previous work showing situational attributions for inconsistency and to models of meaning change in impression formation. (49 ref) (PsycLIT Database 1985)

Ericsson, K. A. and H. A. Simon (1980). "Verbal reports as data." Psychological Review **87**(3): 215-251.

Proposes that verbal reports are data and that accounting for them, as well as for other kinds of data, requires explication of the mechanisms by which the reports are generated, and the ways in which they are sensitive to experimental factors (instructions, tasks, etc). Within the theoretical framework of human information processing, different types of processes underlying verbalization are discussed, and a model is presented of how Ss, in response to an instruction to think aloud, verbalize information that they are attending to in short-term memory (STM). Verbalizing information is shown to affect cognitive processes only if the instructions require verbalization of information that would not otherwise be attended to. From an analysis of what would be in STM at the time of report, the model predicts what could be reliably reported. The inaccurate reports found by other research are shown to result from requesting information that was never directly heeded, thus forcing Ss to infer rather than remember their mental processes. (112 ref) (PsycLIT Database 1980)

Fawcett, G. (1993). "Using students as think aloud models." Reading Research and Instruction **33**(2): 95-103.

Suggests that "think alouds" (TAs) have been used as a qualitative research methodology for some time. In the last decade TAs have moved from the realm of data collection into instruction since B. Davey (1983) proposed TA instructions in which teachers are encouraged to TA in order to model strategies good readers use to construct meaning. Such a suggestion implies a model of learning in which teachers construct knowledge and then transmit it to their students. The author suggests that using students as TA models represents an advance in the theory of knowledge as socially constructed and represents more authentic thinking. Problems of the TA process and limitations in use with young children are noted. Implementation of student TAs, accompanied by research on the effectiveness of this approach, has the potential to positively impact learning. (PsycLIT Database 1994)

Fehrenbach, C. R. (1991). "Gifted/average readers: Do they use the same reading strategies?" Gifted Child Quarterly **35**(3): 125-127.

Compared the reading processing strategies of 30 gifted readers with those of 30 average readers in Grades 8, 10, and 12. 14 reading processing strategies were identified using think-aloud protocols as a measuring instrument. The strategies used significantly more often by gifted readers were rereading, inferring, analyzing structure, watching or predicting, evaluating, and relating to content area; these strategies could be called "effective" strategies. The strategies used significantly more often by average readers were word pronouncing concern and summarizing inaccurately; these strategies could be called "ineffective." (PsycLIT Database 1992)

Finegold, M. and R. Mass (1985). "Differences in the processes of solving physics problems between good physics problem solvers and poor physics problem solvers." Research in Science and Technological Education **3**(1): 59-67.

Examined problem-solving abilities of 12th-grade physics students divided into 2 groups: good problem solvers (GPSs) and poor problem solvers (PPSs). Ss in the 1st group were identified by their teachers as excelling in problem solving, with final graduating grades in physics of at least 90%. Those in the 2nd group were identified by their teachers as experiencing difficulties in problem solving, even though they did have the necessary knowledge, with final graduating grades in physics of above 60%. Ss were asked to solve 4 physics problems in topics studied during the current school year and were encouraged to think aloud as they worked. Written solutions together with oral recordings were examined with reference to problem translation, planning, method of solution, checking, time spent on solution, and proportion of total time spent on planning. Results show that GPSs, in comparison to PPSs, were better able to translate the problem statements, plan their solutions, solve the problems more quickly, and make greater use of

physical reasoning. Results are discussed in terms of G. Polya's (1957) 4 stages of problem solving. (6 ref) (PsycLIT Database 1986)

Fisher, A. and M. Fonteyn (1995). "An exploration of an innovative methodological approach for examining nurses' heuristic use in clinical practice." Scholarly Inquiry for Nursing Practice **9**(3): 263-276.

Examines the feasibility of using the think aloud (TA) method in cardiovascular and neurosurgical clinical settings to learn how experienced nurses reason and what heuristics are used in decision making. TA data were collected from 3 registered nurses both within and outside of their specific areas of expertise. Results show that TA can be used in clinical settings without jeopardizing patient safety or unit routine. Protocol analysis was utilized to identify and describe the heuristics that permitted nurses to evaluate patient data, assess patient status, and make decisions necessary to maintain patient stability. 5 heuristics were identified: pattern recognition, attending, anchoring, focused questioning, and listing. Anchoring and attending were not evident when reasoning outside of expertise whereas listing and questioning were used in these situations suggesting that these may be more common strategies used in everyday thinking. (PsycLIT Database 1997)

Fonteyn, M. E., B. Kuipers, et al. (1993). "A description of Think Aloud method and protocol analysis." Qualitative Health Research **3**(4): 430-441.

Provides specific guidelines for using the Think Aloud (TA) method and conducting protocol analysis. TA studies provide rich verbal data about reasoning during a problem-solving task. Using TA and protocol analysis, investigators can identify the information that is concentrated on during problem solving and how that information is used to facilitate problem resolution. From this, inferences can be made about the reasoning processes that were used during the problem-solving task. In the past, the validity of data obtained from TA studies has been suspect because of inconsistencies in data collection and the inability to verify findings obtained from the laborious process of protocol analysis. (PsycLIT Database 1994)

Ford, J. K., N. Schmitt, et al. (1989). "Process tracing methods: Contributions, problems, and neglected research questions." Organizational Behavior and Human Decision Processes **43**(1): 75-117.

Conducted a meta-analysis of the body of literature using process tracing approaches (e.g., verbal protocol analyses, information board methodologies) to study decision making. 45 studies (published from 1964 to 1988) were identified for this review and study characteristics were coded. Results demonstrate that noncompensatory strategies were the dominant mode used by decision makers. Compensatory strategies were typically used only when the number of alternatives and dimensions were small or after a number of alternatives had been eliminated from consideration. Findings also indicate that information processing in decision making is contingent on the demands of the task faced by the decision maker. The cost/benefit analysis framework of L. R. Beach and T. R. Mitchell (1978) is used as an integrative framework and as a guide for identifying needed directions for futue research. (PsycLIT Database 1989)

Fox, J. E. and B. K. Houston (1983). "Distinguishing between cognitive and somatic trait and state anxiety in children." Journal of Personality and Social Psychology **45**(4): 862-870.

Attempted to develop self-report measures of cognitive and somatic trait and state anxiety for children and to evaluate the utility of distinguishing between cognitive and somatic anxiety. 67 4th-grade children anticipated and then performed a mathematics task either in a high- or low-stress condition. While Ss anticipated performing the task, measures of 7 cognitive behaviors were obtained by means of both a "think aloud" procedure and a questionnaire. Results indicate that the trait and state measures of cognitive and somatic anxiety were reliable. The trait measures of cognitive and somatic anxiety were relatively impervious to induced anxiety states. As expected, cognitive trait

anxiety but not somatic trait or state anxiety was related to task performance. High cognitive state and/or trait anxiety was associated with more preoccupation and performance denigration as well as taking less of an analytic attitude toward the situation. Somatic trait and state anxiety were associated with preoccupation. Results support the construct validity of the measures developed and the utility of distinguishing between cognitive and somatic anxiety in children. (22 ref) (PsycLIT Database 1984)

Fox, J. E., B. K. Houston, et al. (1983). "Trait anxiety and children's cognitive behaviors in an evaluative situation." Cognitive Therapy and Research **7**(2): 149-154.

Investigated the cognitive behaviors of 30 high and low trait-anxious 4th-grade children under stress. Six categories of cognitive behavior were inferred from a Think Aloud procedure that took place while Ss anticipated taking an important arithmetic test. The children's trait anxiety scores from the State-Trait Anxiety Inventory for Children were found to be related to the extent to which the Ss responded to the stressful situation with the cognitive behaviors of preoccupation, justification of positive attitude, and derogation of other. These results parallel those found with adults and suggest that there is a continuity from at least elementary school years to adulthood in some of the cognitive behaviors exhibited by high and low trait-anxious individuals under stress. Only a longitudinal study, however, can fully assess this notion. It was found that the Think Aloud procedure for assessing children's cognitive behaviors had considerable utility. (15 ref) (PsycLIT Database 1983)

French, F. and C. French (1994). "Knowledge forms and career decision making: A component of multidimensional evaluation. Special Issue: Issues and solutions for evaluating career development programs and services." Canadian Journal of Counselling **28**(4): 318-325.

Advocates the evaluation of career development programs and services through a multidimensional approach, using adaptations from methodologies found in evaluating cognitive instructional programs. Accessing the various forms of knowledge necessary in career decision making through introspective, retrospective, and observational procedures is explored. These forms of knowledge include declarative, procedural, strategic, and self-knowledge. Assessing changes in content knowledge is insufficient in evaluating the effectiveness of career development programs and services. Rather, alternative approaches must be used to assess other forms of knowledge. Such approaches can include the in-basket technique, cognitive information processing, the presentation of real-life scenarios, and think-aloud procedures. (French abstract) (PsycLIT Database 1995)

Fuhrer, U. (1985). "Handlungsanalyse durch Setting-Programm-Analyse. (Performance analysis using behavior-setting programs.)." Zeitschrift fur Experimentelle und Angewandte Psychologie **32**(2): 194-216.

Analyzed the actions of 22 table tennis beginners. The cognitive processes of the players were recorded by requiring them to think aloud during experimentally interpolated interruptions of the game. Their verbal reports were then content-analyzed. A high percentage of reported cognitions were related to the action of playing table tennis. Ss also reported significantly more action-related cognitions than non-action-related cognitions, because playing table tennis is thought to involve action-related cognitions. However, no differences could be recorded between the action-related or non-action-related cognitions of the winners and those of the losers, a result that is due to low reliability and low validity of the postexperimental division of the Ss among winners and losers. (32 ref) (PsycLIT Database 1986)

Fulk, B. M. (1994). "Mnemonic keyword strategy training for students with learning disabilities." Learning Disabilities Research and Practice **9**(3): 179-185.

Discusses the difference in motivation for academic tasks between learning disabled students (LDSs) who believe that academic failure is caused by low ability and those who believe that academic success is due to hard work. The keyword strategy for

remembering a new word is described. Seven studies of keyword transfer are summarized and listed. A 7-phase instructional plan for keyword strategy training is presented, with sample scripts for instructors. These phases are (1) provide a purpose, (2) provide explicit strategy-attribution instructions, (3) think aloud during generation of keyword strategies, (4) provide verbal practice, (5) provide guided practice with feedback, (6) provide explicit instructions for transfer, and (7) incorporate attribution training. (PsycLIT Database 1995)

Fulkerson, K. F., J. P. Galassi, et al. (1984). "Relation between cognitions and performance in math anxious students: A failure of cognitive theory." Journal of Counseling Psychology **31**(3): 376-382.

Investigated the cognitions of 34 high- and 37 low-anxious undergraduates in solving mathematical problems by asking them to think aloud while solving problems from the College Board Scholastic Aptitude Test. Cognitions generated from this procedure were examined for sex and anxiety-related differences and were used in a regression equation to predict performance. Results show that 2nd-step cognitive variables (review of information, strategic calculations, conclusions, neutral statements, and silence) did account for a significant amount of variance in the combined performance problems beyond that of the 1st step cognitions (attention control, self-facilitation, irrelevancies, and self-inhibition). It is suggested that cognitive and cognitive-behavioral approaches to counseling should be subject to empirical verification if a strong data base for these interventions is to be created. (40 ref) (PsycLIT Database 1984)

Gabel, D. L., R. D. Sherwood, et al. (1984). "Problem-solving skills of high school chemistry students." Journal of Research in Science Teaching **21**(2): 221-233.

Interviewed 266 high school chemistry students from 10 classes in 8 schools using a think-aloud technique to determine Ss' skills in solving problems involving moles, stoichiometry, the gas laws, and molarity. Data were coded. Results show that successful Ss and those with high proportional reasoning ability used algorithmic reasoning strategies more frequently than did nonsuccessful and low proportional reasoning Ss. The majority of all Ss solved the problems using only algorithmic methods and did not understand the chemical concepts on which the problems were based. (10 ref) (PsycLIT Database 1984)

Gaboury, A., R. Ladouceue, et al. (1988). "Dimensions cognitives et comportementales chez les joueurs reguliers et occasionnels au blackjack. (Cognitive dimensions and behaviors among regular and occasional blackjack players.)." International Journal of Psychology **23**(3): 283-291.

Studied cognitive methods and behaviors among regular and irregular gamblers while playing blackjack. Human subjects: 15 male and female Canadian adults (mean age 38 yrs) (regular gamblers). 15 male and female Canadian adults (mean age 33 yrs) (irregular gamblers). Ss were asked to play blackjack during a 30 min session and to think aloud while playing. All words and verbalizations during the session were recorded. Verbalizations, the amount of money bet on each turn, the S's perception of control, and the S's motivation were compared between regular and irregular gamblers. The questionnaire by A. Letarte et al on risk, chance, and ability in determining the outcome of a gambling game was used to assess the Ss' perception of control after a training period, after 15 min of playing, and at the end of the game. (English abstract) (PsycLIT Database 1990)

Galperin, P. J. and N. P. Kotik (1983). "Luovan ajattelun psykologiaa. / Psychology of creative thinking." Psykologia **18**(4): 243-246.

Six humanities and technological majors (Group 1), 5 elementary education majors with previous problem-solving experience (Group 2), and 4 mathematics majors (Group 3) were administered 8 problems to study the mechanisms of and conditions producing creative insight. Ss were asked to think aloud during problem solving. Group 1 solved approximately half of the problems using familiar, practical methods. Group 2 solved most

of the problems on a perceptive level using early developmental "movement-experimentations" in difficult cases. Group 3 solved all the problems by analyzing them systematically before attempting to solve them. Considering the common features of correct answers in all groups, the authors conclude that the major aspects of intellectual problem solving are opening the main road to the solution, getting rid of familiar concepts, and paying attention to commonly overlooked details. (PsycLIT Database 1984)

Gans, J. S. (1994). "Indirect communication as a therapeutic technique: A novel use of countertransference." American Journal of Psychotherapy **48**(1): 120-140.

Presents a technique to deal with therapeutic impasse in the treatment of resistant or very troubled patients. The novel feature of this technique is the indirectness with which therapists communicate with patients. Therapists think aloud while not looking at their patients; patients "overhear" rather than hear. In their soliloquies, therapists make use of their countertransference for therapeutic purposes. Vignettes illustrate the productive use of this technique in 3 clinical situations: ambivalence regarding patienthood; unilateral, precipitous termination; and profound power differential between therapists and patients. Several factors contribute to therapists' concerns about using this technique: the need to appear sane, fears of relinquishing eye contact, and apprehension over exploring the projective field. Instances when the use of indirect communication is contraindicated are discussed. (PsycLIT Database 1994)

Gilhooly, K. J., P. McGeorge, et al. (1997). "Biomedical knowledge in diagnostic thinking: The case of electrocardiogram (ECG) interpretation." European Journal of Cognitive Psychology **9**(2): 199-223.

Examined the role of biomedical knowledge concerning underlying anatomy and pathophysiology in diagnosis in the context of ECG interpretation. S groups comprised 10 registrars (experts) and house officers (intermediates) employed by the Aberdeen Royal Infirmary and 9 3rd-yr medical students (novices). Ss attempted to reach diagnoses for 8 travces varying in difficulty. On-line, think-aloud protocols were taken and the last diagnostic trace was followed by a surprise memory test for that trace. Expertise effects were found in diagnostic accuracy and confidence and in incidental ECG trace recall following diagnosis. Analyses of think-aloud protocols indicated that biomedical thinking was more prevalent in the ECG domain for experts vs less skilled Ss and in explanation vs diagnostic tasks. Biomedical knowledge was mainly invoked to evaluate possible diagnoses. The correct diagnoses of the traces are appended. (PsycLIT Database 1997)

Gilliland, S. W. and N. Schmitt (1993). "Information redundancy and decision behavior: A process tracing investigation." Organizational Behavior and Human Decision Processes **54**(2): 157-180.

Studied the effects of information redundancy (IR) on decision behavior using a process-tracing decision task. IR was defined in terms of dimension similarity as indicated by dimension labels and as actual intercorrelations among the values on several dimensions. Time constraints on the decision task were manipulated to investigate possible interaction between constraints and redundancy. 140 undergraduate students (aged 17-53 yrs) completed 3 job choice tasks on a computer, each of which involved selecting 1 best job from among 10 job offers. Ss examined less information and for longer durations with the redundant information dimensions. Interactions were found between actual and expected redundancy. Although time constraints were found to limit depth and latency of information search, no interactions were observed between constraints and redundancy. (PsycLIT Database 1993)

Golding, J. M., K. L. Roper, et al. (1996). "To forget or not to forget: The effect of probability of test on directed forgetting." Quarterly Journal of Experimental Psychology Human Experimental Psychology **49a**(2): 326-340.

Conducted 2 experiments with 116 undergraduates to investigate how Ss used explicit memory cues that designate different probabilities of test. As in typical directed

forgetting studies, Ss received words explicitly cued as having either a 0% or a 100% chance of being on a subsequent memory test (i.e., forget and remember cues, respectively). Some words were explicitly cued as having the potential to be either forgotten or remembered (i.e., a 50% cue). Recall of 50% words was between that of 0% and 100% words. The presence of 50% words lowered recall of the 100% words compared to that of control Ss that did not receive the 50% words, but received the same number of 100% words. A think-aloud task indicated that these results were due to the 50% words being treated like either 100% or 0% words at encoding. Results are discussed in terms of the effect of different probabilities of test on the strategic processing and representation of information. (PsycLIT Database 1997)

Goldsmith, R. W. (1976). "Compound probability assessment in a judicial context application of a "think-aloud" technique." Psychological Research Bulletin, Lund U. **16**(3): 12.

Studied normativeness of probability estimates and strategies of thinking and information processing. Nine law students presented with fictitious criminal case material estimated probabilities of events related to the question of guilt. Ss deviated from the normative model P(AB) * P(A) P(B/A), overestimating the probabilities of compound as compared to component events. Results of a "think-aloud" technique provide support for the construct validity of the normative model. Ss who conformed more closely with the model more frequently showed signs in their verbal protocols of being analytical (referring to subhypotheses) and critical (doubting the credibility of evidence)--characteristics considered normative in science. Their protocols were also longer, suggesting more active search activity. (PsycLIT Database 1977)

Green, A. J. and K. J. Gilhooly (1990). "Individual differences and effective learning procedures: The case of statistical computing." International Journal of Man Machine Studies **33**(1): 97-119.

Examined individual differences in procedures for learning to use a statistical computing package among 36 students who were computer novices. Ss provided think aloud protocols over sessions of learning to use the package. Success in learning depended on use of particular learning procedures. In Exp 1, 5 faster learners tackled problems in a goal-directed, structured manner, abandoning one approach when appropriate and trying alternative approaches. The 5 slower learners engaged in unsystematic trial and error search, were repetitive in their approaches to problem solving, gave up more frequently, and paid less attention to prompts and error messages. In Exp 2, instructing Ss to use the effective procedures identified in Exp 1 enhanced their performance on statistical computing problems. (PsycLIT Database 1990)

Greene, S. (1994). "The problems of learning to think like a historian: Writing history in the culture of the classroom. Special Issue: The teaching and learning of history." Educational Psychologist **29**(2): 89-96.

Discusses the cognitive demands of writing and learning in history, and the extent to which students and historians share assumptions about historical report-writing and problem-solving. Constructivist theories of reading and writing that account for the roles of task and context in learning are reviewed. The author summarizes his earlier findings (S. Greene, 1993) of matches and mismatches between students' and historians' interpretations of the tasks of writing reports and problem-based essays. Analysis of think-aloud protocols and retrospective accounts suggests that discourse knowledge, topic knowledge, and disciplinary knowledge distinguish the groups' approaches to these tasks. Perhaps the most striking difference was in sense of audience. Historians constructed task representations with no explicit audience, whereas students did so with the teacher as their audience. Implications for history education are discussed. (PsycLIT Database 1995)

Griffiths, M. D. (1993). "Pathological gambling: Possible treatment using an audio playback technique." Journal of Gambling Studies **9**(3): 295-297.

Proposes a "think aloud" method for treating problem gamblers. Informal feedback from an S who participated in a study (M. D. Griffiths, 1990) that used an audio playback technique to analyze cognitive biases of fruit machine gamblers supports the use of this technique to inhibit irrational gambling bias. (PsycLIT Database 1994)

Grobe, S. J., J. A. Drew, et al. (1991). "A descriptive analysis of experienced nurses' clinical reasoning during a planning task." Research in Nursing and Health **14**(4): 305-314.

A think aloud method was employed to collect verbal data from 7 clinical nurses as they reviewed a written case study and formulated a plan of care. Protocol analysis of the verbal data resulted in a visual representation of each S's plan of care and provided information regarding the clinical data that Ss used to plan care. Results demonstrate that frequently problems and interventions were inextricably linked and considered in unison rather than during separate steps of a planning process. This finding has implications relative to the current practice within both nursing education and nursing service of focusing on problems and interventions separately when planning care. (PsycLIT Database 1992)

Groenland, E. A. G., A. A. A. Kuylen, et al. (1996). "The dynamic process tracing approach: Towards the development of a new methodology for the analysis of complex consumer behaviours." Journal of Economic Psychology **17**(6): 809-825.

Describes the development of the Dynamic Process Tracing Approach (DPTA). DPTA may be particularly useful for the longitudinal analysis of idiosyncratic consumer behavior patterns. After a description of the assumptions and the purposes of the DPTA approach, the procedures and analysis approaches involved in carrying out the DPTA methodology are described in the context of a study involving 12 Ss on saving and financial management. It is shown that the complex consumer choice processes involved in the selection of saving products can be decomposed in sets of behavior traces which offer a deeper insight into the psychological and situational factors guiding overt consumer behaviors. The results show the advocated approach may have intrinsic merits, both from a scientific and from a practical or commercial point of view. (PsycLIT Database 1997)

Guthrie, J. T., S. Weber, et al. (1993). "Searching documents: Cognitive processes and deficits in understanding graphs, tables, and illustrations." Contemporary Educational Psychology **18**(2): 186-221.

Two studies explored a cognitive processing framework for how people read and understand graphs, tables, and illustrations. In Study 1, 16 undergraduates provided verbal protocol data in think-aloud tasks with 4 graphs and 4 illustrations taken from textbooks and newspapers. Ss answered questions that required them to either locate specific details in the documents (local search) or see trends and understand the gist of the documents (global search). In local search, Ss reported thinking about the organization and category structure of the documents. In global search, Ss reported making generalizations and developing abstractions. Study 2, using 55 undergraduates, employed a larger set of documents as well as global and specific questions. Performance on all tasks revealed 1 factor requiring local search and a 2nd factor requiring global search. It appears that performance on the 2nd factor benefitted from abstraction processes. (PsycLIT Database 1993)

Guttentag, R. (1995). "Children's associative learning: Automatic and deliberate encoding of meaningful associations." American Journal of Psychology **108**(1): 99-114.

60 4th and 5th graders completed a paired-associate learning task in 1 of 3 experiments. In Exp 1, Ss were shown related and unrelated words under deliberate memorization and item-specific, incidental-learning conditions. Cued-recall performance (CRP) was superior with related pairs (RPs) relative to unrelated pairs (URPs) in both conditions, suggesting that the encoding of an association between items occurred automatically with meaningfully related words. Results from Exp 2 showed that using a verbal elaboration strategy required more time with URPs than with RPs, suggesting that

using an elaboration strategy was easier with related materials. In Exp 3, strategy was monitored on-line using a think-aloud procedure. CRP was superior with RPs when Ss used rehearsal. Elaboration produced equivalent levels of recall with both types of items, but Ss used the strategy successfully more often with RPs than with URPs. (PsycLIT Database 1995)

Haaga, D. A. F., G. C. Davison, et al. (1994). "Mode-specific impact of relaxation training for hypertensive men with Type A behavior pattern." Behavior Therapy **25**(2): 209-223.

Multimodal therapy calls for selection of interventions on the basis of the specific modes of functioning that they are expected to affect. Mode-specificity assumptions were tested in a study of progressive muscle relaxation (PMR) training for Type A men with borderline hypertension. It was expected that PMR would be especially effective in reducing psychophysiological reactivity and not effective for hostile cognition or behavioral anger expression. 43 Ss were randomly assigned to a control group receiving medical information or to information + PMR. PMR Ss reduced blood pressure reactivity to an anger-instigating role-play more than did controls. Although trait questionnaire measures of hostility and outward anger expression showed no group differences, a think-aloud measure of hostility and an observational measure of anger expression favored PMR. (PsycLIT Database 1994)

Haas, C. (1989). "Does the medium make a difference? Two studies of writing with pen and paper and with computers." Human Computer Interaction **4**(2): 149-169.

Compared the efficiency and quality of 15 experienced writers' (aged 24-42 yrs) persuasive letters written with (1) pen and paper (PP), (2) standard personal computer (PC) and (3) advanced workstation (AW). When composing with the AW, Ss wrote for longer periods of time and composed longer letters than when composing with PP. Rate of composition (words per min) was similar in all 3 conditions. Letters composed with the PC were poorer in content quality and total quality. Eight of the Ss revised 2 of their letters in the medium with which they were composed. Think-aloud protocols collected while Ss revised their letters were collected and analyzed. Ss exhibited more total planning and more initial planning in the PP conditions, although there was more rereading of text and attending to the medium in the computer conditions. (PsycLIT Database 1990)

Hamm, R. M. (1988). "Moment-by-moment variation in experts' analytic and intuitive cognitive activity." IEEE Transactions on Systems, Man, and Cybernetics **18**(5): 757-776.

Six highway engineers were asked to think aloud while producing formulas that expressed their knowledge of how highway aesthetics, safety, and capacity are determined by sets of relevant factors. Ss' statements were measured with multiple indices of the use of intuitive or analytical cognition, producing a moment-by-moment measure of cognitive activity. Predicted differences found included (1) more analytical cognition on the average in the capacity task than in the aesthetics task and (2) a faster rate of alteration between analysis and intuition on the capacity task. Ss used different average modes of cognitive activity on different subtasks. Findings are consistent with the idea that both analyses and intuition are involved in creativity. (PsycLIT Database 1989)

Harrison, D. A., M. E. McLaughlin, et al. (1996). "Context, cognition, and common method variance: Psychometric and verbal protocol evidence." Organizational Behavior and Human Decision Processes **68**(3): 246-261.

Researchers continue to debate the importance of (item) context effects, which are often thought to produce inflated percept-percept correlations in organizational self-reports. Using J. M. Feldman and J. G. Lynch's (see record 76-00164) theory of self-generated validity, the authors propose 5 conditions under which such context effects are most likely to occur and to have an impact on substantive conclusions. The proposed effects are tested with psychometric and verbal protocol data from 208 Ss responding to an organizational justice questionnaire, using a 3 (type of context) by 2 ("think aloud" vs "silent") experimental design. Psychometric results revealed context effects on scale

means, reliabilities, and some of the relations between constructs. Respondents' concurrent verbal protocols from the "think aloud" condition provided evidence for the cognitive basis of these effects. (PsycLIT Database 1997)

Harte, J. M., M. R. M. Westenberg, et al. (1994). "Process models of decision making. Special Issue: Multi-attribute evaluation processes: Judgement and choice." Acta Psychologica **87**(2-3): 95-120.

Examines a parallel between the decision-making research and the general field of problem solving with respect to the analysis of think-aloud protocols. A literature review is conducted of the types of analyses used in studies on decision making in which think-aloud protocols were collected. Results indicate that only 4 of the 23 decision studies involve the construction of process models that are common in problem-solving research. Possible objections against think-aloud data are discussed, and the construction and use of process models in decision-making research are illustrated by means of an information display board task in which Ss were asked to think aloud. Similarities and dissimilarities between decision making and general problem solving and their implications for the construction of process models are discussed. (PsycLIT Database 1995)

Hawkins, S. A. (1994). "Information processing strategies in riskless preference reversals: The prominence effect." Organizational Behavior and Human Decision Processes **59**(1): 1-26.

Established the mediating role of decision processes in determining the occurrence and pattern of riskless preference reversals. In a process tracing experiment, 24 undergraduate and graduate students evaluated a number of 2 attribute apartments using 2 different response modes: choice and matching. Results replicate previous findings of A. Tversky et al (see PA, Vol 75:31652) of a prominence effect in riskless 2-attribute preferences. In addition, there were differences in process between response modes, and these differences are consistent with previous explanations of riskless preference reversals. (PsycLIT Database 1994)

Heiden, L. A., K. T. Larkin, et al. (1991). "Cognitive response to a cold pressor challenge in high and low blood pressure reactive subjects." Journal of Psychosomatic Research **35**(6): 679-685.

Examined the relationship between cognitive and cardiovascular reactions to a cold pressor challenge in 20 high and 20 low blood-pressure-reactive male university students. Ss were trained using a think-aloud procedure and asked to report their thoughts aloud during task presentation. Compared with low-reactors, high-reactive Ss exhibited greater increases in systolic and diastolic blood pressure, but not heart rate, in response to the task. High-reactive Ss reported fewer distracting self-statements than low-reactors during the task and a greater frequency of positive self-statements. No group differences in neutral or negative self-statements were observed. Findings corroborate the importance of distraction strategies in mediating acute cardiovascular reactions to stress. (PsycLIT Database 1992)

Heineken, E., H. J. Arnold, et al. (1992). "Strategien des Denkens bei der Regelung eines einfachen dynamischen Systems unter verschiedenen Totzeitbedingungen. / Strategies of thinking in controlling a simple dynamic system under different deadtime conditions." Sprache and Kognition **11**(3): 136-148.

Studied the effects of duration of dead-time (i.e., system response latency) on cognitive strategies in the regulation of a simple dynamic system. 36 university students (mean age 25 yrs) worked on a computer-simulated temperature regulation system under different dead-time conditions (0, 2, or 8 time units). Half of the Ss were informed about the effects of dead-time, the other half were not. Ss were asked to think aloud while learning to regulate the system and (after the experiment) to develop hypotheses concerning the system's operating principle. Interactions between dead-time duration and

Ss' regulation strategies and performance were analyzed. (English abstract) (PsycLIT Database 1993)

Henry, S. B., D. B. LeBreck, et al. (1989). "The effect of verbalization of cognitive processes on clinical decision making." Research in Nursing and Health **12**(3): 187-193.

Examined the effect of verbalization of cognitive processes on performance on a computer-assisted clinical simulation. 60 pediatric nurses were assigned to 1 of 3 groups: instructions to think aloud, instructions to recall decision processes, or no instructions to verbalize. The experimental groups did not differ on proficiency or efficiency scores on the computerized clinical simulation. Two-way analyses of variance (ANOVAs) revealed no main or interaction effects when examining type of verbalization instructions by level of education, years of pediatric experience, or case familiarity, suggesting that there was no apparent effect of verbalization of cognitive processes on performance regardless of level of expertise. Findings support the use of verbalization of cognitive processes as a strategy to examine clinical decision making. (PsycLIT Database 1989)

Herman, J. L. and D. C. D. Klein (1996). "Evaluating equity in alternative assessment: An illustration of opportunity-to-learn issues." Journal of Educational Research **89**(4): 246-256.

Compared affluent suburban, low-SES urban, and mixed-SES rural schools for access to learning opportunities appropriate to the California Learning Assessment System (CLAS) Middle Grades Mathematics Performance Assessment. Opportunity to learn included variables likely to influence student performance, including access to resources and high-quality instructional content and processes, extra-school opportunities, and direct preparation for the CLAS. Data collection included teacher interviews, student surveys, student retrospective think-aloud interviews, and classroom observations of the assessment administration. Differences between school types in various opportunity-to-learn measures are discussed. Overall, most teachers already engage students in CLAS-appropriate instruction. Despite innovative instruction, urban students were found to be struggling, raising questions about the quality of learning measures and instructional practices. (PsycLIT Database 1997)

Hesse, F. W. and C. Hahn (1994). "Die Rolle der Kontextahnlichkeit beim analogen Problemlosen. (The role of contextual similarity in analogical problem solving.)." Sprache and Kognition **13**(2): 90-102.

Studied the influence of contextual similarity between the target problem and the source problem on transfer processes in analogical problem solving. Human Ss: 57 normal male and female German adults (university students) (Study I). 58 normal male and female German adults (university students) (Study II). Study I compared analogical problem-solving performances under 3 different conditions, i.e., using a context-free, context-similar, or context-dissimilar source problem. Study II compared the effects of semantically similar and dissimilar contexts of the source problem on the utilization of the source problem in solving the target problem. In both studies, Ss were asked to think aloud while working on the target problem. (English abstract) (PsycLIT Database 1995)

Heyneman, N. E., W. J. Fremouw, et al. (1990). "Individual differences and the effectiveness of different coping strategies for pain." Cognitive Therapy and Research **14**(1): 63-77.

Investigated the relationship between individual differences in self-statements and response to self-instruction (SI) and attention-diversion (AD) coping strategies for acute pain. 68 female undergraduates were given 2 cold pressor arm immersions. Ss were asked to think aloud all thoughts occurring on both trials. On the basis of a median split of negative thinking emitted during the 1st or baseline trial, Ss were classified as catastrophizers (CASs) or noncatastrophizers (NCATs). Ss were randomly assigned to receive SI or AD treatments or to a no-treatment control condition and were then given the 2nd cold pressor trial. NCAT Ss trained with AD improved their tolerance scores

significantly more than those trained with SI. However, CAS Ss trained with SI showed greater improvement in tolerance scores than those trained with AD. (PsycLIT Database 1990)

Hogenraad, R. and E. Orianne (1983). ""A penny for your thoughts": Imagery value and periodicity of interior monologue." Journal of Mental Imagery **7**(1): 51-61.

Attempted to differentiate the dynamic and the structural organization of interior monologs. 22 psychology graduate students were instructed to think aloud continuously for 3 hrs. Computerized content analysis of the recorded data yielded idiosyncratic factors with appreciable percentages of variance. Periodic detection analyses on the factor z-scores as input showed the presence of multiple but unmistakable periodicities in the content of interior monolog, focused on the periods of 60 and 90 min. In addition, the imagery value of the nouns present in the monologs was tapped through an imagery dictionary devised for the purpose: Similar periodicities were also found to operate at this level. None of these results was due to random phenomena or to degree of verbal fluency. The need to overcome the idiosyncratic nature of the factors of the monolog suggests a new approach in which the monolog is conceived of as a primitive and prelogical--regressive--mode of thought that seems to be a condition of inventiveness in cognition and behavior. (16 ref) (PsycLIT Database 1984)

Hong, E. (1995). "Mental models in word problem-solving: A comparison between American and Korean sixth-grade students." Applied Cognitive Psychology **9**(2): 123-142.

Investigated students' problem and mathematical models, and their impact on student performance in problem-solving (PS) in 42 American and 44 Korean 6th grade students. Ss were given 7 elementary arithmetic word problems involving addition, subtraction, multiplication and division, in individual PS sessions, to allow the use of the "think-aloud" protocol. Teachers' rated Ss' performances, and significance of the correct mental models used by Ss was determined. Results show significant differences between US and Korean 6th graders in some categories of problem and mathematical models. While many Korean Ss' PS steps were proceduralized, this was not the case for US Ss. The majority of Ss who used correct problem models classified the problem rapidly, according to solution procedures as they read or restated the problems, focusing on the specific words relating them to other statements in the problem. (PsycLIT Database 1996)

Hong, L. W. (1988). "Human judgment and decision making: Models and applications." Indian Journal of Behaviour **12**(4): 1-15.

Discusses 2 types of models of judgment and decision making. The 1st type of model assumes that humans are rational decision makers and focuses on the development and application of normative decision rules based on formal, logical analyses derived from economic or statistical considerations. The 2nd type of model focuses on the interaction of processes when people actually go about making judgments and decisions. Methodology used in investigating these models includes think-aloud protocols, regression analyses, and heuristics and strategies. (PsycLIT Database 1989)

Hotta, A. (1993). "(Influences of critical opinions on the process of discourse production.)." Japanese Journal of Educational Psychology **41**(4): 378-387.

Studied the effects of criticism on statement of opinions in 2 experiments. In Exp 1, 41 undergraduates were subdivided into 3 groups (self-criticized, criticized, and control) and were asked to write their opinions. After they had received critical opinions, they were asked to write their opinions again. In Exp 2, 29 undergraduates were tested as in Exp 1 except that, after receiving critical opinions, they were asked to elaborate their original essays using a think-aloud method. (English abstract) (PsycLIT Database 1994)

Houston, B. K., J. E. Fox, et al. (1984). "Trait anxiety and children's state anxiety, cognitive behaviors, and performance under stress." Cognitive Therapy and Research **8**(6): 631-641.

Evaluated the relations between trait anxiety in children and state anxiety, cognitive behaviors, and performance in a single study in which 2 levels of stress were experimentally manipulated. 67 4th-grade children (41 females, 26 males) anticipated and then performed a mathematics task in either a high- or a low-stress condition. While Ss anticipated performing the task, measures of 7 cognitive behaviors were obtained by means of both a think-aloud procedure and a cognitive behavior questionnaire. Ss were also administered the State-Trait Anxiety Inventory for Children. Trait anxiety was found to be related to state anxiety and the cognitive behaviors of preoccupation, and for females, justification of positive attitude. The performance of high but not low trait-anxious Ss was affected by levels of stress. This finding aids in reconciling discrepancies in previous research concerning children's trait anxiety and performance. (20 ref) (PsycLIT Database 1985)

Hughes, J. N. (1985). "Parents as cotherapists in Think Aloud." Psychology in the Schools **22**(4): 436-443.

Presents 2 case studies in which parents served as cotherapists for their sons (a 9-yr-old referred for impulsivity and an 8-yr-old referred for aggression) in Think Aloud, a social cognitive problem-solving program. Parents helped to promote generalization and transfer of training outcomes, and their role in the program included cognitive modeling, reinforcing, providing problem situations from the prior week, and extending training through generalization tasks at home. Both boys showed improvement as a result of the program. (14 ref) (PsycLIT Database 1986)

Hurst, R. W. and M. M. Milkent (1996). "Facilitating successful prediction problem solving in biology through application of skill theory." Journal of Research in Science Teaching **33**(5): 541-552.

The purpose of this study was to identify cognitive factors associated with differences in predicting problem-solving success among high school biology students, and to determine whether guided practice facilitated successful prediction. The Group Assessment of Logical Thinking was used to evaluate Ss' cognitive operational level; written prediction worksheets and think-aloud interviews were used to measure predictive success and identify problem-solving tendencies. Treatment group Ss received 8 hrs of directed prediction practice using interactive computer simulations, whereas the control group practiced prediction without focusing on specific skills, after which all Ss were retested. Predictive reasoning success showed a significant correlation to both formal operational development and 5 specific cognitive skills: (a) identifying relevant knowledge in long-term memory, (b) using a systematic problem-solving strategy, (c) applying cause-effect reasoning, (d) reviewing solutions for logical inconsistency, and (e) evaluating alternative solutions. Analysis of covariance (ANCOVA) indicated significantly increased prediction success for treatment group Ss following practice in the 5 identified skills. (PsycLIT Database 1997)

Hutchinson, N. L. (1994). "Evaluating career development in school-based programs: Performance assessments. Special Issue: Issues and solutions for evaluating career development programs and services." Canadian Journal of Counselling **28**(4): 326-333.

Suggests the use of performance assessments in career development interventions conducted in the classroom. Examples are drawn from Pathways, a recently developed Canadian program for career development. Pathways is designed for students with learning disabilities, those at risk for dropping out of school, and regular secondary students. It consists of 5 instructional modules focusing on awareness of self and careers, employment writing, interview skills, problem solving on the job, and anger management. Students work in pairs and small groups, think aloud, and learn through role play and real tasks. Each of the 5 modules contains performance assessments that may be used as pre- and posttest indicators to show growth. Limitations of performance assessment are discussed, followed by recommendations for practice and research. (French abstract) (PsycLIT Database 1995)

Jansen, A. (1988). "Over-eten, lijnen en gedachten: Een experimentele studie. / On eating, slimming and cognition." Gedragstherapie **21**(4): 339-352.

Studied controllability of restrained and unrestrained eating. Human subjects: 40 female Dutch adults (mean age 25.5 yrs) (overeating). Regulation of ice cream intake after a preload was studied in high and low scorers on subscales of the Restraint Scale (C. P. Herman et al, 1978) and Dutch Eating Behavior Questionnaire (T. van Strien, 1986). Tests used: The Rational Behavior Inventory (C. T. Shorkey and V. L. Whiteman, 1977), Irrational Belief Test (R. Jones, 1968), Think Aloud on Tape, and Self-Talk Questionnaire. (English abstract) (PsycLIT Database 1990)

Jausovec, N. (1987). "Individualne razlike v epistemicni in hevristicni strukturi in nekognitivnih komponentah med uspesnimi in neuspesnimi resevalci dobro in slabo definiranih problemov. (Individual differences in epistemologic and heuristic structures and noncognitive components during the successful resolution of well and poorly defined problems.)." Anthropos **5-6**(266-290).

Studied the effect of individual differences in strategies used, degree of stimulus-related behavior and self-reflection, level of emotional activity and abstraction, and depth of concept knowledge on problem-solving ability. Human subjects: 122 normal Yugoslavian adolescents and adults. In Exp I, the Ss were asked to think aloud while solving 3 well-defined and 3 poorly-defined literary problems, give precise definitions of several concepts, and relate these concepts to others. In Exp II, 4 experimental groups received instruction concerning contextual and flexible knowledge, metacognition, and noncognitive processes, while the control group received no instruction. The Ss' performance was compared. (English abstract) (PsycLIT Database 1990)

Jausovec, N. (1991). "Flexible strategy use: A characteristic of gifted problem solving." Creativity Research Journal **4**(4): 349-366.

Investigated the relationship between flexible strategic thinking and problem solving performance. In Exp 1, 16 gifted (GFT), 20 average (AVG), and 20 poor undergraduates performed a number of tasks which were designed to provoke rigidity. GFT students showed fewer rigid answers than did the other 2 groups. In Exp 2, 15 GFT and 15 AVG students from Exp 1 were asked to think aloud while solving problems with open and closed solution situations. The thinking aloud protocols were analyzed by classifying statements into different strategy types. GFT students used a variety of strategies when solving problems and different strategies for different problem types; the AVG students did not. (PsycLIT Database 1992)

Jimenez, R. T. (1997). "The strategic reading abilities and potential of five low-literacy Latina/o readers in middle school." Reading Research Quarterly **32**(3): 224-243.

Investigated the strategic literacy knowledge, abilities, and potential of 5 low-literacy Latina/o students in middle school. Three of the Ss were bilingual in Spanish and English, and they received the majority of their instruction in a special education classroom. The other 2 students were selected from a bilingual at-risk classroom and were Spanish-dominant. Researchers conducted classroom observations, student and teacher interviews, think-aloud data collection sessions, and a formative experiment. The formative experiment consisted of 8 cognitive strategy lessons, which were analyzed to determine Ss' response to intensive cognitive strategy instruction. Ss were also encouraged, as appropriate, to make use of their bilingual language abilities. With instructional support, Ss implemented the focal strategies that were emphasized during the formative experiment and were able to profit from instruction, activities, and experiences with print that led to the development of more sophisticated conceptualizations concerning literacy. (PsycLIT Database 1997)

Johnson, E. J., R. J. Meyer, et al. (1989). "When choice models fail: Compensatory models in negatively correlated environments." Journal of Marketing Research **26**(3): 255-270.

Examines the robustness of linear models in mimicking noncompensatory processes in correlated environments. A Monte Carlo simulation demonstrates that certain noncompensatory rules are poorly fit by linear models, even in orthogonal environments, and that this fit diminishes further in nonorthogonal environments. Two laboratory experiments assess the extent to which such model failure might arise in natural contexts. The first, a process-tracing analysis, examines the decision strategies consumers use in nonorthogonal choice environments. The second explores the ability of a compensatory choice model calibrated on actual choices to predict decisions made in orthogonal and nonorthogonal contexts. (PsycLIT Database 1989)

Johnson, E. J., J. W. Payne, et al. (1988). "Information displays and preference reversals." Organizational Behavior and Human Decision Processes **42**(1): 1-21.

Explored the impact of information format on preference reversals that occur when a decision maker prefers one option to another in one response mode but reverses that ordering when preferences are elicited in another response mode. It was hypothesized that presenting probability information in a more complex format would increase the difficulty of the task, cause a shift in processing strategies, and increase the frequency of preference reversals. Results of 2 experiments with a total of 172 university students show that when probabilities were displayed in a format that appeared harder to process, the frequency of reversals was increased. Process-tracing evidence suggests that decision-makers also shifted information processing strategies as a function of information format. (PsycLIT Database 1988)

Johnson, M. M. (1993). "Thinking about strategies during, before, and after making a decision." Psychology and Aging **8**(2): 231-241.

Two studies examined the impact of think-aloud and self-report instructions on the decision-making performance of young and older adults. Findings from Study 1 indicated that think-aloud instructions increased total time to decision for young and older adults but did not otherwise affect decision-making processes. Counter to predictions, the only significant interaction effect indicated that young adults in the think-aloud condition more frequently rechecked information than older adults. Findings from Study 2 confirmed the nonreactive nature of self report methods. Despite potential age-related decrements in cognitive function, differences in functioning are not compounded and cannot be explained by the think-aloud or self-report instructions used by cognitive aging researchers. (PsycLIT Database 1993)

Johnson, P. E., I. Zualkernan, et al. (1987). "Specification of expertise. Special Issue: Knowledge acquisition for knowledge-based systems: II." International Journal of Man Machine Studies **26**(2): 161-181.

Describes a framework for representing the expertise required to perform a task. The framework is based on a procedure employed by cognitive scientists and psychologists in research to understand human problem-solving and decision-making processes. The procedure consists of giving individuals real or simulated tasks to perform and asking them to "think aloud" while they work. The comments such individuals make are referred to as verbal protocols, and the techniques used to analyze these comments are collectively termed protocol analysis. An application of this methodology is provided in a case study involving 2 statisticians who were working on a series of industrial design problems. (PsycLIT Database 1988)

Jones, D. R. and D. A. Schkade (1995). "Choosing and translating between problem representations." Organizational Behavior and Human Decision Processes **61**(2): 214-223.

Examined the possibility that under certain conditions decision makers will translate a problem from the representation given to a more familiar or convenient representation. In a videotaped experiment, 48 experienced systems analysts were asked to solve both small and large system design modification problems. Ss received the problems in 1 of 2 external representations: a data flow diagram or an informationally equivalent input-process-output table. A substantial proportion of Ss submitted solutions using a different external representation than the one they were given (i.e., they translated the problem from the given external representation to an other). The size of the problem had no effect on the tendency to translate. Process tracing analysis showed that the choice of representation was usually made very early in the problem-solving process, perhaps before the Ss fully understood how much efffort would be required to solve the problem. (PsycLIT Database 1995)

Katzeff, C. (1988). "The effect of different conceptual models upon reasoning in a database query writing task." International Journal of Man Machine Studies **29**(1): 37-62.

Proposed that database query writing may be viewed as a hypothesis testing activity and determined the components of an appropriate model for efficient use of a database query language. 20 undergraduates were assigned no model, a table model, descriptions of the query language in terms of sets, or descriptions with a general logical explanation. Ss replied to questions by posing queries to a database system. Ss were given questions with 2 types of linguistic structure, involving the intersection or the union of negative sets. Analyses of think-aloud data as well as data on Ss' keystrokes indicated that the 2 set models produced superior performance and facilitated the formulation of correct expected computer replies, allowing for more efficient hypothesis testing. The union of negative sets was more difficult to deal with than the intersection of negative sets. (PsycLIT Database 1989)

Keseling, G. and A. Wrobel (1991). "Pauses, routines, and registers in composing a text. Special Issue: Writing: From psychological research to educational perspectives." European Journal of Psychology of Education **6**(2): 127-134.

Asserts that features of the writing process have to be analyzed in relation to describable linguistic features of the written text, based on research findings. Activities before writing, distributions of writing pauses, and the structure of think-aloud protocols indicate that planning processes are determined by the writers' knowledge of the grammatical system. The role of syntactical structures, text-patterns (registers), and the auditive component of preformulated text segments is analyzed. (PsycLIT Database 1992)

Kindfield, A. C. (1993). "Biology diagrams: Tools to think with." Journal of the Learning Sciences **3**(1): 1-36.

Videotaped individual think-aloud interview sessions with 15 participants who varied in their degree of formal training in genetics that focused on the spontaneous generation and use of domain-specific diagrams during reasoning about the process of meiosis. The more advanced of the 15 participants displayed knowledge-dependent representational variability, fine-tuned their diagrams to the immediate reasoning task, and systematically used their fine-tuned diagrams as tools to think with while reasoning. Results suggest that more advanced pictorial skills and conceptual knowledge coevolve or mutually influence one another in the development of understanding of a subcellular biological process. (PsycLIT Database 1994)

Kirschenbaum, S. S. (1992). "Influence of experience on information-gathering strategies." Journal of Applied Psychology **77**(3): 343-352.

Decision making and situation understanding are related to information-gathering strategies used by experienced, intermediate, and novice decision makers. Differences according to level of experience were predicted for 7 strategies. These predictions were tested in a process-tracing experiment employing a submarine search scenario. The Ss

were 3 groups of naval officers ranging in experience from former commanding officers to students in the 1st course for potential submarine officers. Differences were found among the groups in use of information-gathering strategies, situation understanding, and decision accuracy. The results are discussed in terms of the influence of experience on the decision process and implications for decision aiding. (PsycLIT Database 1992)

Kitchin, R. M. (1997). "Exploring spatial thought." Environment and Behavior **29**(1): 123-156.

Investigated the different ways in which people think about geographical space and formulate answers to cognitive mapping tasks. To try to discover the strategies of spatial thought used in completing a task designed to measure configurational knowledge, 40 undergraduates (aged 18-29 yrs) were interviewed while they undertook 2 of 4 different tests. This was followed by a debriefing interview where respondents could express their feelings and judgments concerning each test. Results indicate that 8 strategies of thought were encountered in conducting the semi-think-aloud protocols that varied greatly in their popularity. One of the most popular strategies employed by Ss to attempt the tasks was to use map imagery in one of two ways: (1) remembering a map that the Ss had seen, typically an ordinance survey map, or (2) construction of maps that contained a minimal structure or only contained features necessary to complete the task. (PsycLIT Database 1997)

Krampen, G. (1987). "Analysen der Antwortprozesse bei der Bearbeitung von Fragebogenitems. (Analysis of the processes involved in responding to questionnaire items.)." Diagnostica **33**(4): 289-300.

Studied the processes involved in responding to the German version of H. Levenson's (1974) IPC (internal, powerful others, and chance control) Questionnaire. Human subjects: 30 male and female German adults (mean age 28 yrs) (high educational level). The Ss were asked to think aloud while answering IPC items and to rate the 3 questionnaire scales with regard to their face validity. Content analysis of recorded thinking-aloud utterances determined the frequency of general vs item-specific associations, semantic problems, intraindividual and interindividual comparisons, and "construct pure" vs interactive associations. (English abstract) (PsycLIT Database 1989)

Kulhavy, R. W., K. A. Woodard, et al. (1993). "Using maps to remember text: An instructional analysis." British Journal of Educational Psychology **63**(1): 161-169.

45 undergraduate students produced think-aloud data while learning 1 of 3 versions of a reference map. Following map learning, the Ss read a text in which the events were related to the map features. Recall of text events was associated with accurate encoding of map structure. Results support the assumption that the structural quality of the map and the resulting map image are important for the recall of associated text. (PsycLIT Database 1993)

Kunz, G. C. and U. Drewniak (1991). "Metakognitives Strategiewissen als Bedingung der Selbstregulation beim Lernen mit Instruktionstexten. / Metacognitive strategy knowledge as a prerequisite of self-regulation in learning from instructional text." Zeitschrift fur Padagogische Psychologie **5**(3): 201-213.

Studied the role of metacognitive strategy knowledge in learning from instructional texts. Human Ss: 20 normal male and female West German adults (mean age 24 yrs) (university students). Ss' metacognitive strategy knowledge (i.e., knowing how to learn) was assessed via interviews and questionnaires. In the 1st part of the experiment, Ss worked on a computerized instructional text and were subsequently asked to reconstruct their thoughts during the learning task. In the 2nd part of the experiment, Ss were asked to think aloud while working on another instructional text. Learning behaviors and performances were registered via computer. Correlations between metacognitive strategy knowledge and self-regulatory cognitions, learning behaviors, and learning performances were analyzed. (English abstract) (PsycLIT Database 1992)

Langley, D. J. (1995). "Student cognition in the instructional setting." Journal of Teaching in Physical Education **15**(1): 25-40.

Examined the focus of student cognition within a skill-learning setting, and the factors influencing their cognitive ability, by examining 2 aspects of cognition: perspectives and thoughts. Four sources of data were collected from 20 undergraduates enrolled in a 10-wk bowling course and their instructor: daily student reports; field notes (observational & interpretive notes, & fieldwork journal); informal interviews; and verbal reports of student thoughts during "think-aloud" sessions. Results reveal that Ss' perspectives and thoughts were characterized by a central theme involving errors in task performance. Ss' physical and psychological states and improper bowling mechanics were major causes of such errors. Various intervening factors and strategies were used by Ss to resolve errors. Social-historical context of the physical activity setting may provide an important mediating influence on Ss' expressed perspectives and thoughts. (PsycLIT Database 1996)

Langston, C. A. and W. E. Sykes (1997). "Beliefs and the Big Five: Cognitive bases of broad individual differences in personality." Journal of Research in Personality **31**(2): 141-165.

Examined how the Big Five traits of personality (Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness) work at the level of proximal mental processes to causally determine behavior. The authors argue that the constructs of the cognitive approach to personality (e.g., beliefs, expectancies, and subjective values) can be used to provide proximal, causal explanations of individual differences. Two studies were reported demonstrating the initial steps in this effort. Study 1 used think-aloud assessment techniques to measure the beliefs of 83 undergraduates. These interviewer-assessed beliefs were then shown to be significantly correlated with individual differences in standard self-report personality questionnaires. Study 2 assessed 86 university students' beliefs via a self-report measure and found beliefs to be significantly correlated with scores on standard personality questionnaires. The authors argue that individual differences along the broad trait dimensions of the Big Five can be explained via individual differences in general beliefs people hold about themselves and the social world. Future directions and limitations of this approach are discussed. (PsycLIT Database 1997)

Lavoie, D. R. (1993). "The development, theory, and application of a cognitive-network model of prediction problem solving in biology." Journal of Research in Science Teaching **30**(7): 767-785.

Identified and compared undergraduate students' procedural and declarative knowledge associated with solutions to prediction problems in biology. Cognitive scripts associated with successful and unsuccessful predictors were also identified. A cognitive-network model of the prediction problem-solving process is described. 13 secondary science education majors and 12 elementary science education majors provided written predictions and explanations for 10 problems. Four other students from each class solved the problems in think-aloud interviews. The mechanism of successful prediction, characterized by hypothetico-predictive problem solving, was shown to be dependent on a complex interplay between procedural and declarative knowledge. Hypothetico-predictive processing involved inductive if-then reasoning associated with expanding knowledge and generating rules, as well as deductive if-then reasoning associated with generating specific predictions. (PsycLIT Database 1994)

Lawson, M. J. and M. Chinnappan (1994). "Generative activity during geometry problem solving: Comparison of the performance of high-achieving and low-achieving high school students." Cognition and Instruction **12**(1): 61-93.

The problem-solving performance of 5 high-achieving (HA) students and 5 low-achieving Year 11 students was compared during an exercise to solve geometry problems, using a think-aloud procedure. Ss also undertook knowledge assessment tasks involving theorem recall and a prompted recall task to provide estimates of knowledge

available for access during the solution attempts. Detailed analysis of problem-solving protocols indicated that HA Ss not only accessed a greater body of geometrical knowledge but also used that knowledge more effectively. On the more difficult problems, these HA Ss generated more information, used that generated information to access further relevant knowledge, and showed more frequent management of their processing behavior. The nature of the difference in generative activity of 1 S from each of the 2 groups is illustrated. (PsycLIT Database 1994)

Lawson, M. J. and D. N. Rice (1987). "Thinking aloud: Analysing students' mathematics performance. 11th National Conference of the Australian Association of Special Education (1986, Adelaide, Australia)." School Psychology International **8**(4): 233-244.

Presents a framework for analyzing think-aloud data from concurrent verbalization during problem solving, using data from a male Australian Year 10 student. The S completed a think-aloud problem and results were coded on an 11-category scale that included strategy, checking, planning, metacognitive knowledge, and solution. Results indicate that analysis can identify types of student difficulties and where they occur. Guidelines for designing a think-aloud program for classroom use are offered. (PsycLIT Database 1989)

Layton, C., P. J. Smith, et al. (1994). "Design of a cooperative problem-solving system for en-route flight planning: An empirical evaluation." Human Factors **36**(1): 94-119.

Evaluated the impact of alternative design concepts on the performance of 30 airline pilots interacting with such a cooperative system designed to support enroute flight planning. Results demonstrate that different system design concepts can strongly influence the cognitive processes and resultant performances of users. Based on think-aloud protocols, cognitive models are proposed to account for how features of the computer system interacted with specific types of scenarios to influence exploration and decision making by the pilots. Results show that, at least for the foreseeable future, it will be infeasible to fully automate tasks such as en-route flight planning given the current state of technology. (PsycLIT Database 1994)

Levin, I. P. and J. D. Jasper (1995). "Phased narrowing: A new process tracing method for decision making." Organizational Behavior and Human Decision Processes **64**(1): 1-8.

Presents a process tracing technique that combines elements of traditional process tracing methods and methods designed to study the prescreening of choice options and the formation of consideration sets. To demonstrate its usefulness, data are presented from a consumer decision making task in which 100 undergraduates were asked to narrow the number of options over 3 successive decision stages from 18 to 6 to 3, and finally to 1. By examining the attribute values of the options selected at each stage, unique insights were gained into how both decision strategies and the impact of each attribute changed during the decision process and how these changes were related to measurable individual difference factors. The method (i.e., phased narrowing) is compared to and offered as a supplement to traditional process tracing approaches. (PsycLIT Database 1996)

Lindberg, E., T. Garling, et al. (1987). "Prediction of residential preferences and choices from beliefs about the attainment of life values." Umea Psychological Reports **189**(18 p).

Investigated whether residential preferences, acceptance of housing alternatives, and residential choices could be predicted from Ss' beliefs about the effects of different housing attributes on the attainment of a number of life values. A computerized process-tracing technique was used with 36 adults. One, 2, or 6 housing alternatives were presented at a time, and Ss decided which attributes they wanted to obtain information about. The most successful predictions were obtained for preference and acceptance when the alternatives were presented one by one. There were large individual differences with respect to the particular housing attributes and life values, which contributed most to the predictions. (PsycLIT Database 1988)

Lohse, G. L. and E. J. Johnson (1996). "A comparison of two process tracing methods for choice tasks." Organizational Behavior and Human Decision Processes **68**(1): 28-43.

Compared information acquisition behavior for choice tasks using Mouselab, a computerized process tracing tool, and Eyegaze, an eye tracking system in 36 college students. In an experiment using apartment selection tasks and gambles, significant differences contingent on the process tracing method for 10 process tracing measures, including subsequent choices, were found. Computerized process tracing tools increased the amount of time needed to acquire information compared with eye tracking equipment. As a result, Ss using Mouselab tended to have more systematic information acquisition behavior than that observed with eye tracking equipment. (PsycLIT Database 1997)

Londner, L. (1991). "Connection-making processes during creative task activity." Journal of Creative Behavior **25**(1): 20-26.

Conducted an exploratory study with 8 6th graders in a gifted education class who were required to think aloud as they worked on figural drawings taken from the Torrance Tests of Creative Thinking. The Ss' recorded verbalizations were transcribed, and patterns were determined. Three main process variable categories emerged: content bound linking, association shifting, and story weaving. A 4th category was vantage. Ss who evidenced process variables of story weaving most frequently produced more original end products than other Ss. (PsycLIT Database 1992)

Long, D. L. and T. Bourg (1996). "Thinking aloud: Telling a story about a story." Discourse Processes **21**(3): 329-339.

Provides a rationale for the use of verbal protocols in the study of discourse processing. It is argued that readers do not provide a veridical report of their underlying mental processes when they think aloud during text comprehension, but rather construct a text representation and then use it to tell a story about their understanding. Inferential processing during comprehension, individual differences in comprehension performance, and the process involved in conversational discourse and storytelling are discussed. Studies conducted by T. Trabasso and J. P. Magliano (see record 84-06348), R. A. Zwann and C. M. Brown (see record 84-06356), P. Whitney et al (see record 79-22305), and N. Cote and S. R. Goldman (1995) and Cote et al (1995) illustrate the possibilities and limitations of verbal reports. (PsycLIT Database 1997)

Lucas, J. F. (1974). "The teaching of heuristic problem-solving strategies in elementary calculus." Journal for Research in Mathematics Education **5**(1): 36-46.

30 university students participated in an exploratory study which (a) incorporated heuristic problem-solving strategies with the teaching of calculus; and (b) explored related effects on heuristic usage, performance scores, solution time, difficulty, and errors. In the experimental group, heuristic strategies were emphasized by means of inquiry-style, problem-oriented teaching; instruction for the control group was also inquiry-oriented but with no emphasis on heuristics. Pre- and posttest data were generated by requiring Ss to think aloud as they solved mathematical problems-a diagnostic clinical situation. Observed behaviors were analyzed and coded using a specially designed classification scheme. Heuristic Ss demonstrated increased usage of effective approach and planning strategies and significantly superior performance as measured by score ($p < .05$) and reduced difficulty ($p < .02$). Evidence suggests that heuristic-oriented instruction can be an effective mode for teaching mathematical problem solving. (18 ref) (PsycLIT Database 1974)

Lundeberg, M. A. (1990). "Supplemental instruction in chemistry." Journal of Research in Science Teaching **27**(2): 145-155.

Compared the achievement of 103 allied health professional female participants with that of 45 nonparticipants in a supplemental instruction (SI) program for chemistry over 2 yrs. The goals of the SI program were to encourage Ss to (1) develop conceptual understandings; (2) articulate both understandings and misconceptions in a think-aloud

fashion; (3) connect, relate, and integrate scientific information; (4) develop confidence and ability in problem solving; and (5) learn how to learn science. Observations, self-reports, and final grades indicate that SI in chemistry is a low-cost, effective program that students like and attend weekly for 3-hr sessions voluntarily. (PsycLIT Database 1990)

Mack, N. K. (1995). "Confounding whole-number and fraction concepts when building on informal knowledge." Journal for Research in Mathematics Education **26**(5): 422-441.

Examined the ways by which students with limited prior knowledge of fraction symbols can build on their informal knowledge to give meaning to fraction symbols and procedures during instruction. Four 3rd grade and three 4th grade Ss of average mathematical ability received individualized instruction on addition and subtraction of fractions in a 1-to-1 setting for 3 wks. Problems were presented verbally and Ss were encouraged to think aloud as they solved the problems. Results show that as Ss attempted to construct meaning for symbolic representations of fractions, they overgeneralized the meanings of symbolic representations for whole numbers to fractions, and for fractions, to whole numbers. However, Ss may not readily relate symbolic representations to informal knowledge on their own. This suggests that students' ability to relate mathematical symbols to their informal knowledge is influenced by their prior knowledge of symbol systems. (PsycLIT Database 1996)

Magliano, J. P., K. Dijkstra, et al. (1996). "Generating predictive inferences while viewing a movie." Discourse Processes **22**(3): 199-224.

Examined conditions (visual, auditory, and discourse information) that influence predictive inferences while viewing a film. In Exp 1, 24 University of Memphis undergraduate students were instructed to generate predictions while watching the James Bond movie, Moonraker (A. R. Broccoli and L. Gilbert, 1979). The presence of support via visual and discourse modes increased the likelihood that Ss would generate specific predictions. In Exp 2, 10 University of Chicago undergraduate students provided think-aloud protocols at different locations in the film but were not asked to make predictions. As in Exp 1, viewers made predictions when the sources were available, even though they were not instructed to do so. Furthermore, the likelihood that viewers in Exp 2 would generate the same predictions as in Exp 1 also increased as a function of the amount of support. Findings also suggest that viewers generate predictions mainly when the predictions are supported by the film. (PsycLIT Database 1997)

Malone, L. D. and M. A. Mastropieri (1992). "Reading comprehension instruction: Summarization and self-monitoring training for students with learning disabilities." Exceptional Children **58**(3): 270-279.

Studied the effects of summarization training on reading comprehension. 45 middle-school students with learning disabilities were randomly assigned to 1 of 3 reading-comprehension training conditions: (1) summarization training, (2) summarization training with a self-monitoring component, or (3) traditional instruction. All Ss were interviewed before and after training regarding the strategies they typically employed during reading comprehension; during one training session, "think aloud" protocols were collected. Results of comprehension tests indicated that students with learning disabilities trained in summarization procedures performed statistically higher on all dependent measures. In addition, on one far-transfer measure, students who were trained in the monitoring component statistically outperformed those with only the summarization training. (PsycLIT Database 1992)

Mann, L. and C. Ball (1994). "The relationship between search strategy and risky choice." Australian Journal of Psychology **46**(3): 131-136.

Studied the information search patterns used by decision makers to make choices among options with unknown outcomes. 48 college students were administered 25 decision trials on which they could win or lose money. Information search behavior was measured by the DEAN procedure, a process-tracing package for recording and analyzing

information search patterns for problems presented in decision matrix format. The relationship between information search behavior and risky choice was examined. It was found that the individual's search processes and strategies were related to the nature of subsequent choices. Individuals who searched little information were more likely to choose risky, money-losing options. Findings, which demonstrate consistency between search and choice, indicate that different parts of the decision-making process are coherent. (PsycLIT Database 1995)

Marland, P. and B. Osborne (1990). "Classroom theory, thinking, and action." Teaching and Teacher Education **6**(1): 93-109.

Used ethnographic and process-tracing methodologies to explore the nature of a female teacher's theory of action and the relationships between that theory and interactive thinking and specific teaching behaviors in a Grade 12 English class in an all-boys school. Observational and recall interview data were collected over 8 wks. Analyses show that (1) the S held an elaborate, complex, and occasionally problematic theory of action; (2) the structure of lessons and the S's general patterns of teaching behavior adhered closely to her theory; and (3) although the S's interactive thinking shaped many of her teaching behaviors, it contained virtually no reference to her theory of action. (PsycLIT Database 1990)

Mayo, V. D. and J. Tanaka Matsumi (1996). "Think aloud statements and solutions of dysphoric persons on a social problem-solving task." Cognitive Therapy and Research **20**(2): 97-113.

Examined the self-statements of 13 dysphoric and 15 nondysphoric undergraduates during an interpersonal problem-solving task. After completing the Problem Solving Inventory (PSI), Ss were individually shown a brief videotape depicting an interpersonal problem and asked to solve the problem while thinking aloud. Frequencies of 5 self-statement categories were recorded: task-facilitating, task-inhibiting, emotion-focused, problem-focused, and periods of silence. Although the dysphoric Ss rated themselves more negatively on the PSI with regard to their problem-solving abilities, they were actually able to generate as many, and as effective, solutions as the nondysphoric Ss. During problem solving, however, the dysphoric Ss used fewer problem-focused statements and more emotion-focused statements. The frequencies of task-inhibiting and emotion-focused self-statements correlated negatively with the socially validated score of solution effectiveness. (PsycLIT Database 1996)

McGuire, K. L. and C. R. Yewchuk (1996). "Use of metacognitive reading strategies by gifted learning disabled students: An exploratory study." Journal for the Education of the Gifted **19**(3): 293-314.

Examined the use of metacognitive strategies by 4 upper elementary gifted students (aged 10-12 yrs) with reading disabilities during a reading comprehension think-aloud task. Ss had Wechsler Intelligence Scale for Children--Revised (WISC--R) Verbal or Performance IQS above 125 and standardized reading achievement scores at least 1 yr below grade placement. Results indicate that, although Ss actively monitored their reading and reported frequent use of evaluation, paraphrase, and regulation metacognitive strategies, they were not proficient in executing the strategies effectively. Analysis of S profiles revealed significant individual differences in implementation of strategies, indicating a need for individualized reading instruction matched to student profiles. (PsycLIT Database 1997)

McPherson, S. L. (1993). "The influence of player experience on problem solving during batting preparation in baseball." Journal of Sport and Exercise Psychology **15**(3): 304-325.

Examined how conceptual knowledge concerning batting preparation develops with playing experience and how this knowledge influences decision making during a simulated game situation. 12 experts, their coach, and 12 novices viewed a half-inning of a videotaped collegiate baseball game and assumed the role of the 4th batter. Propositional-

type analysis of Ss' think-aloud protocols revealed experts' conceptual representation of batting preparation enabled them to search through a highly restricted problem space, which facilitated the development of sophisticated condition-action rules used to solve the problem. Experts' rules were more tactical, refined, and associated compared to novices' rules. Experts were different from novices in what attributes were considered important to solving the problem. Experts generated self-regulatory strategies to update, check, and modify their predictions of pitcher characteristics. (PsycLIT Database 1994)

Meiran, N., T. Netzer, et al. (1994). "Do tests of nonverbal decoding ability measure sensitivity to nonverbal cues?" Journal of Nonverbal Behavior **18**(3): 223-244.

Compared to efficient decoders (EDCs), inefficient decoders (IDCs) may (1) use a restricted repertoire of nonverbal cues, (2) use the same repertoire but be less sensitive to the cues, or (3) be more sensitive to cues of high informative utility and less sensitive to cues of lesser utility. In these experiments Ss were asked to identify romantic heterosexual couples in photographs. Potential cues were generated by think aloud protocols (Study 1; 10 adults) and their presence and informative utility were determined through ratings (Study 2; 10 adults). Study 3 (62 adults) estimated cues' influence on "couple" decisions. Decisions were affected by all the informative cues, with EDCs being more sensitive to proximity than were IDCs. However, IDCs were more sensitive than were EDCs to uninformative cues suggesting couples' similarity. Hence, the present test does not measure sensitivity but rather, sensitivity-tuning. (PsycLIT Database 1995)

Meyers, J. (1988). "Diagnosis diagnosed: Twenty years after." Professional School Psychology **3**(2): 123-134.

Describes an assessment technique derived from the process assessment model: the think-aloud protocol analysis. Three bases for a conceptual shift in assessment are discussed: the link between assessment and intervention, the link between assessment and the environment, and assessment of the learning process. It is contended that think-aloud protocol analysis is useful because it offers an approach to assess the learning process with specific implications for intervention designed to improve reading comprehension. (PsycLIT Database 1989)

Meyers, J. (1988). "Reactions diagnosed." Professional School Psychology **3**(2): 153-156.

Responds to comments of J. R. Bergan (see PA, Vol 76:10250), B. Y. Wong (see PA, Vol 76:10319), and G. Alessi (see PA, Vol 76:10243) on the article by the present author (see PA, Vol 76:10292). Four issues are discussed: conceptions of behavior focused on the individual's characteristics, norm-referenced vs process assessment, think-aloud analysis, and premature dissemination. (PsycLIT Database 1989)

Meyers, J. and S. Lytle (1986). "Assessment of the learning process. Special Issue: Competence and instruction: Contributions from cognitive psychology." Exceptional Children **53**(2): 138-144.

To reconceptualize current approaches to assessing children with learning problems, the use of techniques derived from recent work in cognitive psychology is proposed. A modification of current assessment practice, termed process assessment, is described that emphasizes intervention, the environment, and the learning process. It is argued that assessment techniques derived from a cognitive perspective can be used to assess interpersonal behavior as well as academic behavior and that these techniques can be used to develop intervention plans. The analysis of think-aloud protocols to evaluate the strategies used in reading comprehension is described that is consistent with the process assessment model and has specific implications for intervention designed to improve reading comprehension. A case example of a 4th-grade girl is used to illustrate this approach. The S showed sustained gains after interventions were developed to address identified deficits in her metacognitive awareness of reading processes. (30 ref) (PsycLIT Database 1987)

Meyers, J., S. Lytle, et al. (1990). "Think-aloud protocol analysis: An investigation of reading comprehension strategies in fourth- and fifth-grade students." Journal of Psychoeducational Assessment **8**(2): 112-127.

Investigated S. Lytle's (unpublished) think-aloud protocol analysis as part of a systematic effort to develop an assessment procedure focused on the tactics used to facilitate reading comprehension. Data are presented for 27 4th-grade and 9 5th-grade students that show the degree to which Ss used reasoning, elaboration, signaling understanding, analysis, judging, and monitoring doubts while they were reading 3 fictional passages. The percentage of each move used by individual Ss was stable across the 3 stories. Significant correlations were obtained between comprehension of the passage used to obtain the think-aloud protocols and 2 of the 6 categories of moves: reasoning and signaling understanding. These students used elaboration, signaling understanding, and reasoning most frequently, and they rarely used analysis and judging. (PsycLIT Database 1991)

Midanik, L. T. and A. M. Hines (1991). ""Unstandard" ways of answering standard questions: Protocol analysis in alcohol survey research." Drug and Alcohol Dependence **27**(3): 245-252.

Presents an historical overview of protocol analysis and assesses the relevance of protocol analysis for evaluating alcohol use questions in surveys. 29 Ss (aged 19-54 yrs) were interviewed and asked to think aloud about their responses to 4 standard alcohol questions: frequency of drinking, average quantity per occasion, frequency of consuming over 5 drinks at 1 time, and frequency of drunkenness. Protocol analysis showed that Ss' primarily used anchoring, adjustment, and context to arrive at their answers. Researchers thus might improve the accuracy of survey responses by providing cues to assist in recall to foster strategies that would provide the information that is being sought. (PsycLIT Database 1991)

Montague, M. and B. Applegate (1993). "Middle school students' mathematical problem solving: An analysis of think-aloud protocols." Learning Disability Quarterly **16(1)**,(Win): Spec Issue 19-32.

Examined the verbalizations of 30 learning disabled (LD), 30 average achieving, and 30 gifted middle school students as they thought aloud while solving 3 mathematical word problems. Ss were given demonstrations and practice in thinking aloud and then solved 1-, 2-, and 3-step word problems. Verbalizations were coded, and between-group and grade comparisons of the number of verbalizations within categories were conducted. The relationship between type of verbalization and overall performance was also analyzed. Findings support K. A. Ericcson and H. Simon's (1980) view of concurrent verbalization as a technique for assessing cognitive processes and H. L. Swanson's (1988) notion that LD Ss may use a qualitatively different approach to problem solving than their nondisabled peers. (PsycLIT Database 1993)

Montgomery, H. (1975). "A study of intransitive preferences using a think aloud procedure." Goteborg Psychological Reports **5**(28): 1-14.

Conducted a replication of A. Tversky's (see PA, Vol 43:6371) experiment on intransitive preferences, employing 5 undergraduates preselected for intransivity. In contrast to Tversky's experiment, Ss were instructed to think aloud. As in Tversky's study, consistent and predictable intransitivities were found. The think aloud data appeared to give valuable information about the Ss' decision-making strategies, because it was possible to describe Ss' choices by means of choice rules that were derived from the think aloud protocols. (PsycLIT Database 1976)

Montgomery, H. and C. M. Allwood (1976). "On the subjective representation of statistical problems." Goteborg Psychological Reports **6**(25): 20 p.

Collected think-aloud data from 19 university students solving 3 statistical problems. Data indicate that the problem-solving process could often be regarded as a successive

development of the problem formulation where each formulation tended to be on the same or on a higher qualitative level than the preceding one. Good problem solvers differed from poor solvers in that they more often (a) referred to an essential concept mentioned in one of the problems, and (b) attempted to clarify the meaning of this concept. From these results and from other data it is tentatively concluded that some of the erroneous problem solutions were due to lack of reflection on how the solution of the problem should be related to the information asked for in the problem. For a problem formulated in a seemingly ambiguous way, Ss' knowledge of the underlying statistical model was positively related to the correctness of their problem interpretation. (PsycLIT Database 1978)

Montgomery, H., M. Selart, et al. (1994). "The judgment-choice discrepancy: Noncompatibility or restructuring?" Journal of Behavioral Decision Making **7**(2): 145-155.

Examined the relative merits of a noncompatibility and a restructuring explanation of the recurrent empirical finding that a prominent attribute looms larger in choices than in judgments. Pairs of equally attractive options were presented to 72 undergraduates who were assigned to 6 conditions in which they performed (1) only preference judgments or choices, (2) preference judgments or choices preceded by judgments of attractiveness of attribute levels, or (3) preference judgments or choices accompanied by think-aloud reports. Results replicate the prominence effect for choices, previously noted by P. Slovic et al (1990), but a prominence effect was also found for preference judgments. Think-aloud protocols indicate that options were more often restructured in choices than in preference judgments. A modified compatibility hypothesis is offered as an explanation for the prominence effect observed for preference judgments. (PsycLIT Database 1994)

Moore, P. (1995). "Information problem solving: A wider view of library skills." Contemporary Educational Psychology **20**(1): 1-31.

Examined the cognitive and metacognitive demands of the initial stages of gathering information for elementary school research assignments in New Zealand. Interactions between areas of knowledge and the metacognitive skills underlying the task were examined. 12 girls and 11 boys in Grade 6 (mean age 11 yrs 8 mo) were recorded on videotape while they participated in individual think aloud/concurrent interviews. Retrospective interviews were used to show those aspects of the task that were not amenable to thinking aloud. The information retrieval and use process in libraries is essentially a problem-solving task that requires various forms of knowledge to be applied very flexibly and in concert. Ss of all abilities were found to have wide-ranging metacognitive knowledge, but overall, they had insufficient general and tactical knowledge to facilitate the use of alternative action paths when a favored approach failed. (PsycLIT Database 1995)

Murphy, M. D., F. A. Schmitt, et al. (1987). "Metamemory in older adults: The role of monitoring in serial recall." Psychology and Aging **2**(4): 331-339.

Older and younger adults were asked to think aloud while studying sets of pictures matched in difficulty for immediate serial recall. When instructed only to remember, young adults tended to study longer, rehearse more, and recall better than did older adults on the most difficult lists. Young adults were also much more likely to spontaneously test themselves during study in the most difficult condition. Older adult groups instructed either to study longer or to self-test, both showed improved recall. Only the older adults who had been instructed to self-monitor, however, recalled better on tests of short-term maintenance and generalization; overt rehearsal data showed that these older adults continued to test themselves. Metamemory deficits may be present with older adults when a strategy, like self-testing, is needed to generate metamemorial knowledge. Strategies such as self-testing can be easily taught, however, and they hold promise of being useful across situations. (PsycLIT Database 1988)

ni Dhiomasaigh, L. and J. McCarthy (1995). "An exploration of implicit and explicit learning and skill level in complex dynamic systems." Irish Journal of Psychology **16**(4): 322-333.

Examined the effect that mode of learning and level of skill have on performance of complex tasks. Research on the control of complex, dynamic systems has identified 2 modes of learning: explicit learning, which occurs under conscious awareness; and implicit learning, which has been described as the acquiring of abstract complex knowledge in a relatively non-conscious manner (A. S. Reber, 1967). Skill level of 60 university students was manipulated at 3 levels: no prior training, 2 training trials and 5 training trials. Explicit learning was induced using the "think aloud" technique. Ss learning implicitly were required to perform a secondary verbal task designed to occupy abstract working memory and to prevent explicit learning. Significant differences in skill levels were found in relation to task performance, ability to verbalize performance strategies, and the number of errors made. Significant differences in modes of learning were not found on any of these dimensions. This study suggests that despite its apparent successful application in previous studies, the secondary verbal task may not have prevented the explicit mode of learning from being engaged. (PsycLIT Database 1997)

Noice, H. and T. Noice (1994). "An example of role preparation by a professional actor: A think-aloud protocol." Discourse Processes **18**(3): 345-369.

Studied how a professional actor used a think-aloud protocol (TAP) to understand a script on a far deeper level than would be provided by a detailed understanding of the story line. S was given a tape recorder and instructed to verbalize his thoughts as they came to him while working on a script. The TAP showed a plan-recognition process by specifying the relationship between the aspects of the text attended to and the information derived from them. The S's analysis was a 2-stage process. He focused on structure, punctuation, and linguistic devices in the script to determine the character's internal states (e.g., intentions and motivations) and specific performance characteristics (e.g., speech and movement patterns) for the purpose of turning it into living conversation. The S's activity is consistent with cognitive factors that recent research has identified as components of the learning process. (PsycLIT Database 1995)

Nolen, S. B. (1995). "Effects of a visible author in statistical texts." Journal of Educational Psychology **87**(1): 47-65.

The effects of a visible author (one who reveals aspects of him- or herself) on women's experience reading statistical texts were examined among 47 female college students who read texts that differed in the extent to which the author revealed attitudes and personality. Data included "think-and-feel-aloud" protocols, measures of concentration, mood, level of perceived challenge, and readers' images of the author. Women reading the visible author text interacted with the author while reading; this relationship appeared to influence the relations among comprehension, motivation, and affective response. For these women, author image and initial self-efficacy for statistics were related to cognitive engagement, feelings of accomplishment, and intrinsic motivation. Implications for text construction and methodology in research on the interaction of cognition and affect during learning tasks are discussed. (PsycLIT Database 1995)

Okebukola, P. A. (1992). "Can good concept mappers be good problem solvers in science?" Research in Science and Technological Education **10**(2): 153-170.

Compared 40 Nigerian college students who had cooperative and individualistic concept-mapping experiences for 6 mo with 20 Ss who had no such experience. Ss were asked to solve 3 biology problems. Written and think-aloud procedures and interviews were conducted as part of the administration of the tests. Ss with concept-mapping experience were significantly more successful than controls. No statistically significant difference was found between students who mapped concepts cooperatively and those who mapped individually. There were mixed results for gender. (PsycLIT Database 1993)

Olshavsky, R. W. (1979). "Task complexity and contingent processing in decision making: A replication and extension." Organizational Behavior and Human Performance **24**(3): 300-316.

Using protocol analysis, the hypothesis that choice strategy is contingent on task complexity was tested. As the number of alternatives increased, 40 graduate students switched from a 1-stage compensatory strategy to a multistage strategy involving a noncompensatory screening stage followed by a compensatory evaluation of remaining alternatives. As the number of attributes per alternative increased, Ss differentially weighted the available information to simplify the choice task. As the complexity of attributes increased, Ss tended to adopt choice strategy with a screening strategy consisting of 2 separate stages. Findings were corroborated by separate analysis of quantitative measures of extent of processing and by separate analysis of latency measures. Further support is provided for the contingent processing hypothesis, the attribute complexity hypothesis, and for the use of protocol analysis as a viable process tracing technique. (24 ref) (PsycLIT Database 1981)

Ormrod, J. E. and L. Jenkins (1989). "Study strategies for learning spelling: Correlations with achievement and developmental changes." Perceptual and Motor Skills **68**(2): 643-650.

Examined strategies used by 20 3rd- and 4th graders, 22 7th- and 8th graders, and 31 undergraduates to learn to spell words. Ss were pretested to identify 10 words that they could not spell, instructed to think aloud as they studied the words, and posttested. Results indicate that (1) amount of study time was not correlated with posttest spelling scores; (2) the 2 most common strategies (word pronunciation, letter rehearsal (LR)) were not correlated with posttest scores; (3) overpronunciation, used only by undergraduates, was correlated .51 with posttest scores; and (4) LR occurred more often among younger Ss. (PsycLIT Database 1989)

Paxton, R. J. (1997). ""Someone with like a life wrote it": The effects of a visible author on high school history students." Journal of Educational Psychology **89**(2): 235-250.

This study investigated the effects of a visible author (one who writes in the 1st person, revealing personal opinions and self) on adolescents reading history textbooks. Six high school sophomores read a passage from a textbook that featured an anonymous author (one who writes in the 3rd person, revealing little about personal opinions and self) and a similar text featuring a visible author. Data from think-aloud protocols and semi-structured interviews were analyzed to understand the impact of these authors on students' construction of historical knowledge and on their attitudes toward the texts and toward the discipline as a whole. Students interacted frequently with the visible author, engaging in mental conversations. These conversations led students to a closer relationship with the information presented in the text. The nature of these relationships, both for the visible text and the anonymous text, is discussed. (PsycLIT Database 1997)

Payne, J. W. and J. R. Bettman (1994). "The costs and benefits of alternative measures of search behavior: Comments on Bockenholt and Hynan." Journal of Behavioral Decision Making **7**(2): 119-122.

Offers a commentary on U. Bockenholt and L. S. Hynan's (see PA, Vol 81:39833) analysis of process-tracing measures of information selection. J. W. Payne and J. R. Bettman agree with Bockenholt and Hynan that individual differences in acquisition behavior need to be addressed and they support Bockenholt and Hynan's latent class approach. (PsycLIT Database 1994)

Payne, J. W., J. R. Bettman, et al. (1988). "Adaptive strategy selection in decision making." Journal of Experimental Psychology Learning, Memory, and Cognition **14**(3): 534-552.

The role of effort and accuracy in the adaptive use of decision processes is examined. A computer simulation using the concept of elementary information processes identified

heuristic choice strategies that approximate the accuracy of normative procedures while saving substantial effort. However, no single heuristic did well across all task and context conditions. Of particular interest was the finding that under time constraints, several heuristics were more accurate than a truncated normative procedure. Using a process-tracing technique that monitors information acquisition behaviors, two experiments tested how closely the efficient processing patterns for a given decision problem identified by the simulation correspond to the actual processing behavior exhibited by subjects. People appear highly adaptive in responding to changes in the structure of the available alternatives and to the presence of time pressure. In general, actual behavior corresponded to the general patterns of efficient processing identified by the simulation. Finally, learning of effort and accuracy trade-offs are discussed. (PsycLIT Database 1988)

Payne, J. W. and M. L. Braunstein (1978). "Risky choice: An examination of information acquisition behavior." Memory and Cognition **6**(5): 554-561.

The monitoring of information acquisition behavior, along with other process tracing measures such as response times, was used to examine how individuals process information about gambles into a decision. 25 college-age Ss indicated preferences among specially constructed 3-outcome gambles. The number of alternatives available was varied across the sets of gambles. A majority of the Ss processed information about the gambles in ways inconsistent with compensatory models of risky decision making, such as the information integration model of N. H. Anderson and J. C. Shanteau (see PA, Vol 44:13837). Furthermore, the inconsistency between observed information acquisition behavior and such compensatory rules increased as the choice task became more complex. Alternative explanations of risky choice behavior are explored. (20 ref) (PsycLIT Database 1980)

Payne, J. W., M. L. Braunstein, et al. (1978). "Exploring predecisional behavior: An alternative approach to decision research." Organizational Behavior and Human Performance **22**(1): 17-44.

Suggests that a trend in the study of decision behavior is the increased emphasis being placed on understanding the psychological processes underlying observed judgments or choices. The input-output analyses used by most decision researchers, however, are fully adequate to develop and test process models of decision behavior. It is argued that data collection methods are needed that will yield data on predecisional behavior in order to identify the information a decision maker has and how it is being processed. Two such process tracing methods, verbal protocol analysis and the analysis of information acquisition behavior, which should be especially valuable in decision research, are illustrated and discussed. The process tracing approach appears to be a valuable complement to more traditional model-fitting approaches to the study of decision behavior. The value of a multimethod approach is illustrated and discussed. (40 ref) (PsycLIT Database 1980)

Perez, R. S. and C. D. Emery (1995). "Designer thinking: How novices and experts think about instructional design." Performance Improvement Quarterly **8**(3): 80-95.

Identified differences in the thinking of novice and expert instructional designers, who were given the same description of a cognitive model of the design process. The study was conducted in 2 phases, the 1st involved interviews with 4 experts in the field of training development and in the 2nd, 9 instructional designers (5 experts and 4 novices) participated in a think aloud task. Results show that experts spent more time exploring the problem than novices and interpreted the problem while the novices identified the problem. Both used different types of knowledge in arriving at their design solutions. The experts considered a large number of factors in combination with one another, while the novices considered fewer factors and one factor at a time. Experts used fewer learner-control strategies than novice designers. It is concluded that tools should be designed to provide flexibility for use. (PsycLIT Database 1996)

Peterson, P. L., R. W. Marx, et al. (1978). "Teacher planning, teacher behavior, and student achievement." American Educational Research Journal **15**(3): 417-432.

Investigated individual differences in teacher planning and the relationship of teacher planning to teacher behavior and student achievement. Each of 12 experienced teachers taught a social studies lesson to 3 groups of junior high students (n = 8) randomly formed from 288 paid volunteers. Before teaching each group, teachers had 90 min to "think aloud" and plan the lesson. Results indicate that, generally, the greatest proportion of planning statements concerned the subject matter, but substantial differences occurred. Planning differences were related to teachers' cognitive styles and abilities. Relationships between teacher planning, teacher behavior, and student outcomes also appeared. (19 ref) (PsycLIT Database 1980)

Pierce, P. F. (1993). "Deciding on breast cancer treatment: A description of decision behavior." Nursing Research **42**(1): 22-28.

Explored the unaided decision-making process of women facing treatment for early-stage breast cancer. During an open-ended interview, 48 female patients (aged 25-90 yrs) were encouraged to think aloud about their decision experience. A qualitative analysis of these interviews identified 5 empirical indicators of decision behavior: perceived salience of alternatives, decision conflict, information seeking, risk awareness, and deliberation. The configurations of these indicators discriminated the decision maker into 1 of 3 empirically derived groups. In order of complexity, these are termed Deferrer, Delayer, and Deliberator. (PsycLIT Database 1993)

Pollier, A. (1992). "Evaluation d'une interface par des ergonomes: diagnostics et strategies. / User interface evaluation by human factors specialists: Diagnoses and strategies." Travail Humain **55**(1): 71-95.

Studied the activities of human factors specialists charged with evaluating a human-computer interface. Ss were 4 experienced ergonomists specializing in information systems. Ss were asked to think aloud and to consult with the experimenter while evaluating the human-computer interface in a multimedia communication system. The resulting verbalizations, videotapes of Ss' activities, and Ss' written and graphic productions were analyzed to determine the number and type of ergonomic issues taken into consideration and the strategies used in performing the evaluation. Individual differences in these variables were analyzed. (English abstract) (PsycLIT Database 1993)

Ponterotto, J. G., A. Burkard, et al. (1995). "Prospective minority students' perceptions of application packets for professional psychology programs: A qualitative study." Professional Psychology Research and Practice **26**(2): 196-204.

This article reports the results of a qualitative study designed to determine issues salient in Black and Hispanic American students' review and evaluation of program-application packets in professional psychology. The study served as an extension to the R. K. Yoshida et al (see PA, Vol 76:34552) quantitative investigation. Students interested in pursuing doctoral studies in counseling or school psychology (N = 22) served as the sample. The qualitative methodology incorporated a think-aloud procedure and semistructured interviews. A theme analysis of transcribed interviews identified both major and minor themes central to participants' evaluation of the packets. Major themes included financial aid, program requirements and course descriptions, demography of the student body, and the quality and clarity of application material. Specific suggestions on developing an application packet to send to inquiring prospective students are put forth. It is recommended that such a packet could serve as a cost-effective minority-recruitment strategy. (PsycLIT Database 1995)

Pressley, M. (1994). "Embracing the complexity of individual differences in cognition: Studying good information processing and how it might develop. Special Issue: Developmental perspectives on individual differences in learning and memory." Learning and Individual Differences **6**(3): 259-284.

Describes the good information processing perspective, which suggests that cognitive performance is a product of strategies, nonstrategic knowledge, metacognition, motivation, and short-term capacity. The perspective is supported by: (1) quantitative studies establishing that strategic functioning depends on nonstrategic knowledge, metacognition, motivational beliefs, and capacity; (2) qualitative investigations demonstrating that effective strategies instruction includes teaching of strategies and simultaneous development of nonstrategic knowledge, metacognition, and supportive motivational beliefs; and (3) think-aloud analyses revealing the use of strategies, filtering of new information through prior knowledge, and generation of online metacognition through monitoring. An important next direction is to develop a model of change (i.e., how not-so-good information processors become good information processors). (PsycLIT Database 1995)

Prins, F. J., V. V. Busato, et al. (1996). "Een bijdrage tot de validatie van het (meta)cognitieve deel van de Inventaris Leerstijlen. (A contribution to the validation of the (meta)cognitive part of the Learning Styles Inventory.)." Pedagogische Studien **73**(2): 108-122.

Attempted to create learning style profiles with the Learning Styles Inventory (J. D. Vermunt, 1992). Human Ss: 27 normal male and female Dutch adults (mean age 21.7 yrs) (undergraduate students) (1st-yr psychology students). Ss were selected from a larger group based on their responses on the Learning Styles Inventory. Five Ss with a reproduction-directed learning style, 8 Ss with a meaning-directed learning style, and 14 Ss with an undirected learning style were asked to think aloud while studying a 10-page social psychology text. Differences among the groups in memorization patterns and behavioral features were assessed. (English abstract) (PsycLIT Database 1997)

Pritchard, R. (1990). "The evolution of introspective methodology and its implications for studying the reading process." Reading Psychology **11**(1): 1-13.

Presents an overview of introspective approaches to gaining insight into cognitive processing behavior and traces the application of these approaches in classical psychology, cognitive psychology, 2nd language learning, and reading. The think-aloud procedure used in classical psychology was accompanied by a shift in observer responsibility to the researcher (protocol analysis). In cognitive psychology, distinctions were made among think-alouds, concurrent verbalizations, and retrospective verbalizations. A 3-dimensional model (involving activity, time, and content) for researching cognitive processes in 2nd language learning is noteworthy for its explication of variations of introspection. Implications for studying the reading process utilizing introspective approaches are outlined. (PsycLIT Database 1992)

Pryzwansky, W. B. (1989). "School consultation: Some considerations from a cognitive psychology perspective." Professional School Psychology **4**(1): 1-14.

The cognitive psychology literature examining expert vs novice problem-solving approaches contributes to the conceptualization of school consultation as a problem-solving activity. As an initial step in pursuing those ideas systematically, think-aloud protocols were collected from 11 school psychology students and 21 school psychologists responding to an actual taped consultation case. Preliminary data analyses identified 3 levels of problem finding during the entry state of consultation. Results suggest that the identified levels were not necessarily related to experience or training. (PsycLIT Database 1989)

Putz Osterloh, W. (1974). "(On the effectiveness of problem-solving training.)." Zeitschrift fur Psychologie **182**(3): 253-276.

Tested the effectiveness of 3 training methods for the improvement of problem-solving. Ss were assigned to 4 groups: the tactical group underwent a training exercise; the strategical group received instructions on an optimum strategy for the solution; the super group underwent exercises and strategical instruction; and the control group received no training. All Ss solved 6 logical proof problems during which they were to

"think aloud". The test protocols were translated into uniform steps of solution. In terms of problem solution, the super group was systematically better than the control group. The last 2 problems were also solved better by the strategy group than by the controls. Systematic effects of the training exercise (training in tactics) could not be verified. Analysis of the protocols revealed that the strategical and the super training brought about a change in the method of application of certain steps toward the solution as well as a change in their oganization. Reasons for the varied effectiveness of the training procedures are discussed, and proposals are presented for future examinations. (German & Bulgarian summaries) (32 ref) (PsycLIT Database 1977)

Putz Osterloh, W. (1981). "Uber die Beziehung zwischen Testintelligenz und Problemloseerfolg. (The relation between test intelligence and problem solving success.)." Zeitschrift fur Psychologie **189**(1): 79-100.

Investigated which complex problem-solving processes are predicted by the Raven Advanced Progressive Matrices (RAPM). A computer model of a tailor shop was constructed. It realized problem-solving demands that were similar to those in the RAPM. 48 university students assigned to 3 conditions had to manage the shop individually for 24 simulated months, making as much profit as possible. During problem solving, Ss had to think aloud. In a 2nd session, Ss had to work on the RAPM tasks. The expected correlation between intelligence test performance and success in the problem was not supported. Comparing successful and unsuccessful problem solvers by the use of protocol analysis, problem-solving components responsible for success in tailorshop management were identified, with few systematically related to test performance. (Russian abstract) (20 ref) (PsycLIT Database 1982)

Randall, A., M. M. Fairbanks, et al. (1986). "Using think-aloud protocols diagnostically with college readers." Reading Research and Instruction **25**(4): 240-253.

Discusses the use of thinking-aloud protocols as diagnostic tools for understanding the interactive nature of the reading process and outlines an investigation of 40 student protocols. From analyses of the 40 protocols, a framework was developed for differentiating student-text interactions and identifying common problems less able comprehenders encountered. Diagnostic and instructional issues are discussed. (PsycLIT Database 1987)

Ranyard, R. and D. Abdel Nabi (1993). "Mental accounting and the process of multiattribute choice." Acta Psychologica **84**(2): 161-177.

A. Tversky and D. Kahneman (see PA, Vol 66:11998) discussed how multiattribute choices may be framed in terms of alternative psychological accounts established for specific problems. They identified 3 levels of account: minimal, topical, and comprehensive. The role of these mental accounts was investigated in 2 studies of Tversky and Kahneman's Jacket and Calculator problem. In the 1st study, with 450 Ss, systematic variation of jacket and calculator prices showed that the latter had a large effect on choice, and the former a small but significant effect. It is concluded that the effect of the calculator price supports Tversky and Kahneman's view that people frame simple choices in terms of specific, topical accounts. In the 2nd study, with 48 Ss, think aloud evidence is presented that supports these conclusions and indicates that the level of account adopted may be contingent on characteristics of the choice problem. (PsycLIT Database 1994)

Reid, J. C., C. M. Kardash, et al. (1994). "Comprehension in patient literature: The importance of text and reader characteristics. Special Issue: Communicating with patients about their medications." Health Communication **6**(4): 327-335.

Summarizes 3 studies of patients' comprehension of published material. Study 1 assessed 52 adults, average education 11.9 yrs reading an arthritis pamphlet. Study 2 assessed 26 adults, mean age 57 yrs with a median education level of high school graduate who read a diabetes pamphlet. Study 3 involved 30 male veterans, aged 51-79 yrs, reading about lung cancer. The analysis of patients' think-aloud and recall protocols

suggested several text and reader characteristics that hindered text processing and revealed that immediate recall was low; one-third of Ss had questions that were not answered by the material. Text characteristics that hindered processing included lexical problems, violation of recommended standards of writing, and inadequate repetition or organizers. Reader characteristics that hindered processing included education level, vocabulary skills, and a conflict of pamphlet statements with readers' existing schemas. (PsycLIT Database 1995)

Rips, L. J. (1989). "The psychology of knights and knaves." Cognition **31**(2): 85-116.

In knight-knave brain teasers, knights tell only truths, whereas all others (knaves) tell only lies. In a pilot study, 4 undergraduates were asked to think aloud while solving similar problems. Their statements suggested that they were making assumptions about the knight-knave status of the characters and drawing deductive inferences from these assumptions to test their consistency. This process was then modeled in a simulation based on a natural-deduction theory of reasoning. The model contains a set of deduction rules in the form of productions and a working memory that holds a proof of the correct answer. Two experiments with 97 undergraduates showed that Ss were more likely to make mistakes and take longer to solve puzzles associated with a larger number of proof steps. (French abstract) (PsycLIT Database 1989)

Robert, J. M. (1986). "Etude experimentale de la production de dessin technique. / Experimental study of the production of technical drawing." Travail Humain **49**(1): 1-16.

Analyzed the behavior of 5 professional draftsmen during the manual production of a drawing. Ss were asked to solve a real problem of equipment installation and to produce a complete drawing of their solution. Ss were asked to think aloud while they worked. Four types of data were recorded: (1) Ss' verbalizations, (2) Ss' nonverbal behaviors, (3) the progression of the drawing, and (4) the chronology of the 1st 3 types of data. Ss experienced significant difficulty with the task. Ss' behavior was divided into 5 components: (1) reading, (2) data research, (3) calculation, (4) rough draft, and (5) final drawing. Rapid back and forth transitions among these behaviors were noted. Marked individual differences were noted at various stages of the drawing process. Results indicate some needs that could be satisfied by computer graphic systems. (English abstract) (29 ref) (PsycLIT Database 1987)

Robertson, J. W. (1994). "Usability and children's software: A user-centered design methodology." Journal of Computing in Childhood Education **5**(3-4): 257-271.

Outlines Human Factors usability (US) issues involved in design, development, and implementation of educational software. The lack of attention to educational software US is addressed, followed by a financial evaluation of social spending on educational technology. Industrial US issues are presented, followed by suggestions for ways in which educational software can meet the language, physical, social, and cognitive needs of children. A consideration of current US testing methods is presented, including the application of surveys, as well as heuristic and think-aloud methods for children's software. Guidelines and recommendations are provided for adapting US engineering and testing procedures to educational software to create a quasi-user-centered design approach for educational software development. Suggestions include multidisciplinary design teams, each with individual needs, and including children on testing teams. (PsycLIT Database 1995)

Robertson, W. C. (1990). "Detection of cognitive structure with protocol data: Predicting performance on physics transfer problems." Cognitive Science **14**(2): 253-280.

Presents a cognitive map proposed to be associated with understanding the "system concept," a component of the physics principle of Newton's 2nd law. A definition of the concept is followed by the results of a problem-solving experiment that investigated whether or not good problem solvers possess cognitive structures similar to the one proposed. Think-aloud protocols were collected as 15 undergraduates solved physics

problems involving Newton's 2nd law. Coding schemes were used to analyze these protocols and to develop a quantitative index reflecting the extent to which Ss possessed components of the proposed structure. This index proved a highly significant predictor of performance on Newton's 2nd law transfer problems contained in a written exam. Performance on a set of familiar problems in the same written exam was not a good predictor of performance on transfer problems. (PsycLIT Database 1991)

Rosebery, A. S., B. Warren, et al. (1992). "Appropriating scientific discourse: Findings from language minority classrooms." Journal of the Learning Sciences **2**(1): 61-94.

Studied the effects of a collaborative inquiry approach to science on language minority students' (middle and high school) learning. The focus of the analysis was on changes in Ss' conceptual knowledge and use of hypotheses, experiments, and explanations to organize their reasoning in the context of 2 think-aloud problems. Data are reported from students who are native speakers of Haitian Creole and who completed the school year. 16 students met these criteria: 12 7th and 8th graders and 4 from a high school basic skills class. In September, the Ss' reasoning was nonanalytic and bound to personal experience. They responded as if they were being asked to answer questions in a reading comprehension task. By June, Ss reasoned in terms of a larger explanatory system, used hypotheses to organize and give direction to their reasoning, and demonstrated an awareness of the function of experimentation in producing evidence to evaluate hypotheses. (PsycLIT Database 1993)

Rosman, A., M. Lubatkin, et al. (1994). "Rigidity in decision behaviors: A within-subject test of information acquisition using strategic and financial informational cues." Academy of Management Journal **37**(4): 1017-1033.

Used a within-S design to directly measure rigidity in decision behaviors in structured and ill-structured decision situations, and distinguished between semantic and episodic informational cues. A computer process-tracing technique was also used that allows validity assessments of tests and keeps researcher intrusion to a minimum. In Study 1, 23 commercial lenders and 19 venture capital lenders were presented with 4 hypothetical loan cases. In Study 2, 23 auditors from accounting firms assessed the ability of businesses to continue as going concerns. Results show decision rigidity across and within problem settings; however, these rigidity findings appear to be contingent on the type of information being processed. The 3 groups of Ss acquired some information in a rigid manner and other information in a nonrigid manner. (PsycLIT Database 1995)

Roth, T. (1987). "Erfolg bei der Bearbeitung komplexer Probleme und linguistische Merkmale des Lauten Denkens. / Success in solving complex problems and linguistic characteristics of loud thinking." Sprache and Kognition **6**(4): 208-220.

Studied the relationship between success in solving complex problems and the lexical characteristics of language used when thinking aloud. Two experiments tested the hypothesis that poor problem-solvers use more generalizing, exclusionary language, whereas good problem-solvers use more differentiating language. Human subjects: 32 Germans (Exp I). 28 normal German adults (university students) (Exp II). In Exp I, 32 unpublished transcripts of thinking aloud recorded during attempts to solve a computer-simulated problem were analyzed. In Exp II, Ss were required to think aloud while solving a computer-simulated problem presented either in a realistic or in a fictionalized setting. In both studies, the transcripts were analyzed for certain significant parts of speech using the Dogmatismustextauswertung (dogmatism text analysis) procedure (S. Ertel, 1972). (English abstract) (PsycLIT Database 1989)

Roth, T., H. A. Meyer, et al. (1991). "Sprachgebrauch, Informationsstrukturierung und Verhalten in einer komplexen Problemsituation. / Language use, cognitive differentiation and behavior in a complex decision task." Sprache and Kognition **10**(1): 28-38.

Studied the relationship between problem-solving behaviors and language use while thinking aloud in problem-solving situations. It was hypothesized that high dogmatism

scores and frequent use of negations and conditional phrases are associated with a lack of analytic differentiation in problem analysis and a low flexibility in problem-solving behavior. Human subjects: 59 male and female West German adults (mean age 23 yrs) (university students). Ss were asked to think aloud while managing a complex computer-simulated ecosystem. In addition, Ss were asked to write an essay analyzing the problem situation. Interactions between problem-solving performances, use of negations and conditional phrases, and scores on the "Dogmatismustextauswertung Verfahren" (Dogmatism Text Evaluation Procedure) by S. Ertel (1972) were analyzed. (English abstract) (PsycLIT Database 1991)

Rowland, G. (1992). "What do instructional designers actually do? An initial investigation of expert practice." Performance Improvement Quarterly **5**(2): 65-86.

Conducted a study in which 4 expert and 4 novice designers were asked to think aloud as they solved a design problem. The resulting audiotaped protocols were analyzed and compared. Differences were identified between experts and novices and between apparent characteristics of expertise and descriptions of instructional design in the literature. These differences involved problem interpretation, problem analysis, problem representation, solution generation, the solution, internal and external resources and decision making. Implications for assisting and training instructional designers are discussed. (PsycLIT Database 1992)

Russo, J. E., E. J. Johnson, et al. (1989). "The validity of verbal protocols." Memory and Cognition **17**(6): 759-769.

Tested the reactivity of a think aloud verbal protocol and the veridicality of different retrospective protocols using 24 undergraduates who completed 4 dissimilar tasks: a verbal task (anagrams), a numerical task (choosing between 2 gambles), a pictorial task (Raven's Progressive Matrices), and mental addition of 3-digit numbers. Generating a concurrent protocol altered accuracy in simple addition and a choice between 2 gambles and generally prolonged response times. Such reactivity partially qualifies the dominant theory of protocol generation proposed by K. A. Ericsson and H. A. Simon (1984). Retrospective protocols yielded substantial forgetting or fabrication in all tasks, supporting the consensus on the nonveridicality of these methods. Protocol validity should be based on an empirical check rather than on theory-based assurances. (PsycLIT Database 1990)

Saad, G. (1996). "SMAC: An interface for investigating sequential multiattribute choices." Behavior Research Methods, Instruments and Computers **28**(2): 259-264.

Describes the Sequential Multi-Attribute Choice (SMAC), a computer interface, as a comprehensive data collection tool for distinct stages of sequential choice environments. The interface was developed to implement the full sequential decision making environment. It uses a sequential-sampling model to investigate information search behavior for multiattribute choices. The model assumes that an individual acquires one piece of attribute information at a time, until sufficient cumulative discrimination has occurred to permit a choice. The procedure for eliciting the attribute ranks and importance weights is provided. The interface collects an extensive amount of process-tracing information, which is stored in summary, acquisition, and past-information files. Two data structures are used in the interface, which enable the determination of the attribute values viewed by Ss after obtaining additional attribute information. (PsycLIT Database 1997)

Saroyan, A. (1992). "Differences in expert practice: A case from formative evaluation." Instructional Science **21**(6): 451-472.

Describes formative evaluation by instructional designers and subject matter experts, highlighting their task interpretation, their focus on text features, and their strategies. Ss were 6 experts, 3 professional instructional designers, and 3 professors. Content analysis of protocols based on think-aloud data suggests that instructional designers take on the role of a generalist, use a comparative method of review, and appear to be directed by the heuristics of the instructional systems design model. In contrast, subject matter experts

approached the task as specialists, used a sequential method of review, and seemed to be directed by the domain knowledge. These differences led to the identification of different problems and the generation of different revision recommendations. (PsycLIT Database 1994)

Schmalhofer, F. and I. Schafer (1986). "Lautes Denken bei der Wahl zwischen benannt und beschrieben dargebotenen Alternativen. / Thinking aloud when choosing between alternatives presented by name or description." Sprache and Kognition **5**(2): 73-81.

Studied differences in information processing when choosing between alternatives presented by name or between alternatives presented by description. The object of the study was to evaluate criterion-dependent choice models. Human subjects: 20 male and female German adults (aged 20-28 yrs) (university students). The Ss were asked to think aloud while choosing between named alternatives and between described alternatives. The types and numbers of criteria that the Ss considered during the decision-making process under the 2 conditions were compared. (English abstract) (PsycLIT Database 1989)

Schmidt, H. G. and H. Boshuizen (1993). "Kennisencapsulatie. (Knowledge encapsulation.)." Tijdschrift voor Onderwijsresearch **18**(3): 135-148.

Discusses the concept of encapsulation of declarative knowledge, a learning mechanism that plays an important role in the rapid reasoning of experts. Encapsulation is a "packaging" of lower-level concepts and their interrelationships within a smaller number of higher-level concepts. The results of studies in the medical expertise literature that indicate the existence of encapsulation are reviewed. Encapsulation is responsible for the decrease of references to casual, underlying, biomedical principles in think-aloud studies of Ss with different levels of expertise in diagnosing cases. Encapsulation of the knowledge base is the mechanism underlying such diverse phenomena as intermediate effects in posthoc pathophysiological explanations of clinical cases and the emergence of inferences in free recall of those cases as expertise unfolds. Implications for education are discussed. (English abstract) (PsycLIT Database 1994)

Schmidt, H. G. and H. P. Boshuizen (1993). "On acquiring expertise in medicine. Special Issue: European educational psychology." Educational Psychology Review **5**(3): 205-221.

Presents a new theory of expertise development in medicine that describes expertise development as the progression through a series of consecutive phases. The 1st phase is characterized by the accumulation of causal knowledge about disease and its consequences. Through experience with real cases, this knowledge transforms into narrative structures called illness scripts. The next phase is characterized by the use of episodic memories of actual patients in the diagnosis of new cases. It is assumed that knowledge acquired in different phases forms layers in memory through a sedimentation process. Evidence from intermediate effect studies, think aloud studies, and novice/expert studies is presented to support the theory. (PsycLIT Database 1994)

Scholtz, J. and S. Wiedenbeck (1992). "Learning new programming languages: An analysis of the process and problems encountered." Behaviour and Information Technology **11**(4): 199-215.

Investigated the kinds of learning and transfer that take place in the early stages of using a new programming language (PL) and where difficulties develop. Think-aloud protocols were videotaped as 6 computer science graduate students and 6 professional programmers tried to write a program in a new PL. Ss used 1 of 2 unfamiliar PLs, one similar to their known language (Pascal) and the other dissimilar. Ss spent the majority of time reading a language textbook. Many iterations of Ss trying to implement plans, failing, and having to revise their plans were observed. Examination of Ss' solutions and implementation approaches to Pascal suggest that programmers learning a new PL are often biased by their implementation of algorithms in previous PLs. (PsycLIT Database 1993)

Schweiger, D. M. (1983). "Is the simultaneous verbal protocol a viable method for studying managerial problem solving and decision making?" Academy of Management Journal **26**(1): 185-192.

40 graduate business students performed a computer-simulated executive business game under instructions to "think aloud" or no such instructions. The lack of significant performance differences between the 2 groups indicates that the simultaneous verbal protocol may be used to study individual managerial problem solving and decision making without interfering with the Ss' strategy or performance. Because Ss were not required to focus on specific stimuli or cognitive processes, they were able to attend to the task without serious distraction. (29 ref) (PsycLIT Database 1983)

Short, E. J., S. W. Evans, et al. (1991). "Thinking aloud during problem solving: Facilitation effects." Learning and Individual Differences **3**(2): 109-122.

Three studies examined the assumption that performance is not altered while thinking aloud. Study 1 involved 52 normally achieving 5th graders completing 2 identical sets of analogies. Analyses revealed superior performance while thinking aloud as compared to silent performance. Study 2 was designed to determine the generality of the think aloud findings across diagnostic groups, including 28 learning disabled, 24 developmentally handicapped, and 26 normally achieving 5th graders. All 3 groups profited significantly from thinking aloud on both verbal and spatial analogies. Study 3 examined the generality of the think aloud findings to 22 normally achieving and 22 learning disabled college students. No facilitative effects were experienced by adults. (PsycLIT Database 1993)

Short, E. J., C. Schatschneider, et al. (1991). "The effect of thinking aloud on the problem-solving performance of bright, average, learning disabled, and developmentally handicapped students." Contemporary Educational Psychology **16**(2): 139-153.

Examined the relationship between intelligence and problem-solving ability among 21 bright, 22 average, 26 learning disabled (LD) and 25 developmentally handicapped (DHC) 5th graders. Ss completed the Kaufman Assessment Battery for Children, 22 analogies in a silent condition, and 22 analogies in a think aloud condition. All Ss did better on verbal and spatial analogies while thinking aloud, with LD Ss profiting more on verbal than on spatial problems. Average and bright Ss profited the most and DHC Ss profited the least from thinking aloud. Bright and average Ss were more self-regulated than their handicapped counterparts. LD Ss were superior to DHC Ss in strategic awareness only. Strategic awareness proved to be the best predictor of problem-solving performance. (PsycLIT Database 1991)

Silven, M. and M. Vauras (1992). "Improving reading through thinking aloud." Learning and Instruction **2**(2): 69-88.

Developed a cognitive training program for improving 64 poor and average 6th graders' reading skill. The program was based on T. A. Van Dijk and W. Kintsch's (1983) model. The authors studied whether the impact of the program depended on the quality of the trainer's think-alouds or on guiding Ss in thinking-aloud (TA) task performance. The acquisition and transfer effects of training, together with the effects of Ss' initial ability, are discussed. Ss improved significantly in 5 out of the 7 text-processing strategies practiced. They improved in identifying important text contents and in condensing and connecting text contents. Regarding transfer to gist comprehension and learning, Ss were responsive to the training program when the trainer modeled TA and guided Ss in the activity. (PsycLIT Database 1993)

Simmons, C. J. and J. G. Lynch (1991). "Inference effects without inference making? Effects of missing information on discounting and use of presented information." Journal of Consumer Research **17**(4): 477-491.

In 4 experiments, 632 undergraduates evaluated a focal set of single-attribute product descriptions, along with descriptions of competing brands that systematically altered the

attributes that Ss perceived as missing from the product descriptions. This manipulation selectively increased thoughts about undescribed attributes. It also led to reduced effects of described-attribute levels on product evaluations and lowered evaluations of a target set of products. Neither effect was mediated by inference making. Process tracing data showed that noting an attribute as missing usually was not followed by inferences about its value. Results suggest that discounting and slope effects could result from less complex responses that do not involve inference making. (PsycLIT Database 1991)

Skakun, E. N., T. O. Maguire, et al. (1994). "Strategy choices in multiple-choice items." Academic Medicine **69**(10, Suppl): S7-S9.

Studies the strategies and examines the reasoning employed by medical students responding to multiple-choice questions (MCQs). 33 3rd-yr and 7 4th-yr medical students were presented with 30 medical test MCQs and asked to think aloud while answering the questions, which covered diagnosis, laboratory tests, treatment, and medical concepts. Ss' answers were audiotaped and analyzed. Three broad strategies were identified: (1) reading the stem and proceeding to the question choices (QCs), (2) reading the stem, generating an answer, and checking it against the QCs, and (3) forming a diagnosis, realizing that a diagnosis is not required, and checking the QCs. Quotes from the transcripts are given. Results indicate that answers are not based on simple recall and that different levels of expertise interact with the nature of the task. (PsycLIT Database 1995)

Smith, E. E. and S. A. Sloman (1994). "Similarity- versus rule-based categorization." Memory and Cognition **22**(4): 377-386.

In L. J. Rips's (1989) study suggesting that categorization cannot be reduced to similarity, Ss were presented a sparse description of an object that mentioned only a value on a single dimension, followed by 2 categories where one allowed more variability on the relevant dimension than did the other. In the present research with 80 undergraduates, sparse descriptions like those used by Rips and rich descriptions that contained features characteristic of the nonvariable category were used in Exp 1. Categorization tracked similarity with both kinds of descriptions. In Exp 2, the procedure was modified to be more like that of Rips by requiring Ss to think aloud while making decisions. Consistent with Rips's data, a dissociation was found between similarity and categorization with sparse items. With rich descriptions, categorization again tracked similarity. Data suggest that categorization can be done by similarity and by rule. (PsycLIT Database 1995)

Smith, J. and P. B. Baltes (1990). "Wisdom-related knowledge: Age/cohort differences in response to life-planning problems." Developmental Psychology **26**(3): 494-505.

A research framework and method are presented in which wisdom is conceived as expert knowledge about fundamental life matters. Five criteria of wisdom are specified: Rich factual and procedural knowledge, life-span contextualism, relativism, and the recognition and management of uncertainty. As illustration, discourse about normative and nonnormative life-planning problems associated with different life phases was examined. Verbal think-aloud protocols, collected from 60 Ss (25-35, 40-50 and 60-81 yrs of age), were scored on the wisdom criteria by trained raters. As expected, few (5%) responses were considered wise. These wise responses were equally distributed across age groups. In general, wisdom-related knowledge appears to be one cognitive domain in adulthood that does not show an overall advantage to one age or cohort group but rather reflects individual and specific life experience. (PsycLIT Database 1990)

Smith, J., U. M. Staudinger, et al. (1994). "Occupational settings facilitating wisdom-related knowledge: The sample case of clinical psychologists." Journal of Consulting and Clinical Psychology **62**(5): 989-999.

Wisdom can be defined as expert knowledge in the fundamental pragmatics of life. Examined here is whether clinical practice may facilitate access to and acquisition of such knowledge. Spontaneous think-aloud responses to 2 wisdom-related dilemmas from 12 young (aged 26-37 yrs) and 12 older (aged 65-82 yrs) female clinicians were compared

with responses obtained from 17 young (aged 28-37 yrs) and 19 older (aged 64-75 yrs) other female professionals. Raters judged clinicians' responses as higher on 5 criteria of wisdom: factual knowledge, procedural knowledge, life-span contextualism, value relativism, and management of uncertainty. Contrary to most studies of cognitive aging, young and older adults did not differ. Rather, each age-cohort group received highest ratings when responding to a life dilemma matched to their own life phase. The application of a wisdom framework to assessing therapeutic treatment goals and therapist interventions as well as global changes in client's beliefs during therapy are discussed. (PsycLIT Database 1995)

Smith, M. U. (1988). "Successful and unsuccessful problem solving in classical genetic pedigrees." Journal of Research in Science Teaching **25**(6): 411-433.

Asked 16 undergraduates and 11 graduate students and faculty members to solve 1-3 classical genetics problems that required pedigree analysis, using the think-aloud interview technique. Ss were classified as either successful or unsuccessful, and the performances of these groups were analyzed from videotaped recordings of the interviews. A number of previously reported findings (M. W. Hackling, 1986) were corroborated. Additional observations are discussed in terms of genetic knowledge, use of production rules, strategy selection, use of critical cues, hypothesis testing, use of logic, understanding of issues of probability, and the thinking process itself. Findings evidence a similarity between the solution of pedigree problems and the processes of medical diagnosis and scientific investigation. (PsycLIT Database 1989)

Smith, M. U. and R. Good (1984). "Problem solving and classical genetics: Successful versus unsuccessful performance." Journal of Research in Science Teaching **21**(9): 895-912.

11 undergraduates (novices) and 9 graduate students and instructors (experts) were videotaped as they solved moderately complex genetics problems. Detailed analysis of these "think aloud" protocols resulted in 32 common tendencies that could be used to differentiate between successful and unsuccessful problem solvers. Experts perceived a problem as a task requiring analysis and reasoning and tended to use a knowledge-development (forward-working) approach. They made frequent checks on the correctness of their work, used accurate and detailed bookkeeping procedures, and had a broader range of heuristics to apply to the problem. It is clear that studying problem solving using the expert-novice design requires that the problems be difficult enough to require more than recall and yet simple enough to allow novices a chance for solution. Applying elementary probability concepts seemed to be the most difficult aspect of many of the genetics problems, even for the experts. (24 ref) (PsycLIT Database 1985)

Smith, M. W. (1991). "Constructing meaning from text: An analysis of ninth-grade reader responses." Journal of Educational Research **84**(5): 263-271.

Examined the cognitive processes of 5 successful and 5 less-successful 9th-grade readers used to construct meaning from narrative text through analysis of the think-aloud protocols that Ss recorded as they read 2 stories. After presenting the coding system used to analyze the protocols, the following findings were reported: (1) Ss were engaged primarily in story-driven and association-driven readings rather than in point-driven readings; (2) Ss had a characteristic style of response that was not substantially affected by the type of story that they read; and (3) there were few clear differences between the groups, although some did exist, most notably that the successful Ss tended to rely more heavily on their personal experience than did the less-successful Ss. (PsycLIT Database 1991)

Staudinger, U. M., J. Smith, et al. (1992). "Wisdom-related knowledge in a life review task: Age differences and the role of professional specialization." Psychology and Aging **7**(2): 271-281.

Adopts life review as an avenue to access wisdom-related knowledge and examines the contribution of age and type of professional specialization to individual differences in wisdom-related knowledge. Women from 2 age groups/cohorts (young, M = 32 yrs; old, M = 71 yrs) and different professional specializations (human services vs nonhuman services) were asked to think aloud about the life review of a fictitious woman who was either young or old. Verbal protocols were scored on 5 wisdom-related criteria; factual and procedural knowledge about life, life-span contextualism, relativism of values, recognition, and management of uncertainty. Three major findings emerged. First, human-services professionals outperformed the control group. Second, old adults performed as well as young adults. Third, for older adults wisdom-related performance was enhanced by the match between their own age and the age of the fictitious character. (PsycLIT Database 1992)

Staver, J. R. and A. T. Lumpe (1995). "Two investigations of students' understanding of the mole concept and its use in problem solving." Journal of Research in Science Teaching **32**(2): 177-193.

In Exp 1, 48 university freshmen and sophomores in the summer session of a 1st-yr chemistry course for scientists and engineers responded to an examination question that assessed their understanding of the mole concept and the numerical identity between the atomic or molecular mass of a substance and its molar mass. Ss' most frequent errors were: failing to define the mole in terms of -sup-1-sup-2C, defining the mole as Avogadro's number, defining the mole as a mass, and constructing a logical argument in vague terms or by using improper knowledge. In Exp 2, a think-aloud protocol (TAP) was used with 12 freshmen in a course for students with little or no background in chemistry. Ss' definitions of the mole varied and were connected to their understanding of the numerical identity issue, which impeded their ability to solve 2 problems in the TAP. Results are discussed in terms of research in chemical education and in cognitive science. (PsycLIT Database 1995)

Steinberg, I., G. Bohning, et al. (1991). "Comprehension monitoring strategies of nonproficient college readers." Reading Research and Instruction **30**(3): 63-75.

Examined how nonproficient college readers monitored their comprehension when challenged with the task of reading difficult expository text. Data sources were transcripts of think-aloud sessions and retrospective comments from 20 nonproficient college freshmen. Results describe reading behavior in 2 ways. The first is as a global description of the word-related, sentence-related, and discourse-related strategies used by nonproficient readers. The second is as a process description of how the readers monitor their comprehension when reading proceeds with ease and when problems in understanding occur. Implications for curriculum development and classroom instruction for college reading assistance programs are discussed. (PsycLIT Database 1991)

Stone, D. N. and D. A. Schkade (1991). "Numeric and linguistic information representation in multiattribute choice." Organizational Behavior and Human Decision Processes **49**(1): 42-59.

Conducted a process tracing study of multiattribute choice in which 24 graduate business students made choices among alternative computer information systems. The number and similarity of alternatives were also manipulated to examine interactions of information representation with other task and context variables. Detailed measures of decision processes were collected through concurrent verbal protocols and computer logs. Relative to numbers, words led to more alternative-based information search and less compensatory processing. Also, the number and similarity of alternatives had important moderating influences on the effects of information representation. (PsycLIT Database 1991)

Stratman, J. F. (1994). "Investigating persuasive processes in legal discourse in real time: Cognitive biases and rhetorical strategy in appeal court briefs." Discourse Processes **17**(1): 1-57.

Describes the development of an exploratory think-aloud protocol study of reading, writing, and persuasive processes in legal discourse during an actual state appellate court case. A goal of the study was to examine the methodological feasibility of matching advocates' think-aloud protocol segments while composing their briefs with the corresponding think-aloud protocol segments of 2 court readers during their subsequent process of evaluation and decision. The author examines how cognitive biases may develop in appellate brief writers, how these biases may affect their generation and strategic assessment of persuasive techniques, and how court experts (appellate court clerks) may react to these techniques at initial and subsequent encounters. The persuasive techniques focused on are (1) explicit refutations combined with concessions vs insinuations and (2) 1-sided vs 2-sided case analysis. (PsycLIT Database 1995)

Sundstrom, G. A. (1991). "Process tracing of decision making: An approach for analysis of human-machine interactions in dynamic environments." International Journal of Man Machine Studies **35**(6): 843-858.

Develops principles for support of joint human-machine reasoning processes in dynamic environments. This aim is to separate the representations of the technical system for the representations of the human operator (HO) during design of knowledge-based support systems. An approach is described that focuses on the analysis of information and knowledge acquisition of HOs in supervision and control systems. Information search of HOs is analyzed using the notions of information processing goals, means, and requirements. Three examples (categorization of states, choice of action, and evolution of outcomes of actions) illustrate how information about the value and rate of change of process variables is used in 3 types of reasoning contexts and how they are related to each other, as well as the type of knowledge needed. (PsycLIT Database 1992)

Svenson, O. (1973). "Analysis of strategies in subjective probability inferences as evidenced in continuous verbal reports and numerical responses." Reports from the Department of Psychology, U. Stockholm **396**(10 p).

Analyzed data from an experiment using a think-aloud technique and traditional regression methods to determine what strategies are used when Ss estimate posterior odds, and to compare the results from different dependent variables. In a Bayesian book-bag and poker-chips probability inference task, 20 undergraduates judged the likelihood that a given sample of chips was drawn from each of the 2 bags. Results indicate that in simultaneous presentations of samples the difference between the number of red and blue chips in a sample, as well as the proportions of chips, played a significant role in determining the estimates that showed the effect of conservatism. (PsycLIT Database 1978)

Svenson, O. (1974). "A note on think aloud protocols obtained during the choice of a home." Reports from the Department of Psychology, U. Stockholm **421**(21 p).

Six adult Ss made hypothetical decisions to buy 1 of 7 houses presented in great detail in authentic booklets. Think aloud protocols were tape recorded and coded by 2 independent judges. In the code used, the alternatives were characterized by aspects (pieces of information that a S attends to at a given time) that are represented by values on different attributes or dimensions. Each evaluative mention of an aspect was coded in terms of its attractiveness in 1 of 3 categories. This code system gave a satisfying interjudge reliability and a good description of the decision spaces used by the Ss. Results indicate that (a) the evaluation of an aspect was most of the time absolute, without any explicit comparison with a corresponding aspect of another alternative; and (b) no systematic change of the attractiveness of an aspect over time could be found, but a small number of evaluative statements were intransitive. Furthermore, it was not necessary for the Ss to investigate aspects on all attributes in order to eliminate an alternative. It is

suggested that lexicographic orderings and conjunctive decision rules were used by the Ss. (PsycLIT Database 1978)

Svenson, O. (1979). "Process descriptions of decision making." Organizational Behavior and Human Performance **23**(1): 86-112.

Presents a representation system for the description of decision alternatives and decision rules. Examples of these decision rules, classified according to their metric requirements (i.e., metric level, commensurability across dimensions, and lexicographic ordering) in the system, are given. A brief introduction to process tracing techniques is followed by a review of results reported in process tracing studies of decision making. The review shows that most decision problems are solved without a complete search of information, which shows that many of the algebraic models of decision making are inadequate. When the number of aspects of a decision situation is constant, an increase in the number of alternatives (and a corresponding decrease in the number of dimensions) leads to a greater number of investigated aspects. Verbal protocols showed that decision rules belonging to the different groups were used by decision makers when making a choice. It is concluded that process tracing data can be fruitfully used in studies of decision making but that such data do not release the researcher from the burden of constructing theories or models in relation to which the data must then be analyzed. (47 ref) (PsycLIT Database 1980)

Svenson, O. and G. Karlsson (1986). "Attractiveness of decision alternatives characterized by numerical and non-numerical information." Scandinavian Journal of Psychology **27**(1): 74-84.

164 college students judged the attractiveness of student apartments characterized by the attributes of size, standard, and traveling time to the university. The information describing the apartments was given either in numerical or verbal form. In Exp I, the verbal descriptions were scaled numerically to ensure comparability of the numerical and verbal presentations. In Exp II, Ss gave attractiveness judgments of these alternatives described in all different combinations of numerically and verbally presented attributes. In Exp III, analyses of numerical judgments and think-aloud protocols were used. The most important attribute was traveling time to the university. In general, numerical representation of the most important attribute tended to have somewhat greater impact on attractiveness judgments than verbal descriptions. (PsycLIT Database 1987)

Svenson, O. and H. Montgomery (1974). "A frame of reference for the study of decision processes." Reports from the Department of Psychology, U. Stockholm **409**(14 p).

Suggests that a decision made in a complex situation can be described as a dynamic process, where the decision maker treats and seeks information sequentially. The character of this process is interactive so that certain information may lead to a specific search of complimentary, or reevaluation of already processed, information. Some possible decision rules are presented, and suggestions are given about principles guiding the order of application rules in a decision process. It is assumed that the character of a decision process depends on the decision maker's personality and the situation, but it is also assumed that it is possible to find some fixed sequence of applications of decison rules, information seeking, and reevaluation of information, that have some consistency within and between Ss across situations and individuals. A think-aloud technique is suggested for obtaining data complimentary to other types of data needed for descriptions of decision processes of more complex types. (28 ref) (PsycLIT Database 1978)

Swanson, H. L. (1990). "Influence of metacognitive knowledge and aptitude on problem solving." Journal of Educational Psychology **82**(2): 306-314.

The author investigated whether high levels of metacognitive knowledge about problem solving could compensate for low overall aptitude. To test this hypothesis, a 2 (high-low aptitude) * 2 (high-low metacognitive ability) design was used to analyze children's problem-solving performance. Processing differences between ability groups

were determined through an analysis of "think aloud" protocols. Protocols were analyzed at two levels: (a) grouping of subroutines that function as heuristic processes and (b) grouping of subroutines that function as strategies. Regardless of aptitude, higher metacognitive children performed better than the lower metacognitive children. Higher metacognitive ability groups were more likely to rely on hypothetico-deductive (if-then propositions) and evaluation (check the adequacy of a hypothesis) strategies than was the lower metacognitive group. The results are discussed in terms of the independence of metacognition and general academic aptitude. (PsycLIT Database 1990)

Swanson, H. L. (1993). "An information processing analysis of learning disabled children's problem solving." American Educational Research Journal **30**(4): 861-893.

Investigated whether learning disabled (LD) children's mental processing during problem solving is qualitatively different from average- (AAC) and gifted-achieving (GAC) peers, and whether these processing differences are attributable to metacognitive knowledge. Problem solution, "think-aloud" protocols during problem solving, and metacognitive responses from a questionnaire were analyzed for 63 children (mean age 10.5 yrs) who were either LD, AAC, or GAC. Although LD Ss were comparable to the other ability groups in problem solution, their metacognitive and "think-aloud" responses were distinct. Results support the notion that the problem-solving performance of LD children reflects a weak integration of metacognitive skills with on-line processing and problem solution. (PsycLIT Database 1994)

Swanson, H. L., J. E. O'Connor, et al. (1991). "Problem-solving subgroups as a measure of intellectual giftedness." British Journal of Educational Psychology **61**(1): 55-72.

Within a framework that views intelligence in terms of expert/novice representations, subgroups of children, determined through a hierarchical cluster of "think aloud" protocols, were compared on problem-solving tasks. Ss were 68 4th and 5th graders. Protocols were analyzed at 2 levels: (1) grouping of subroutines that function as heuristic processes and (2) grouping of subroutines that function as strategies. One subgroup was designated a prototype of gifted intelligence based on sophistication of heuristic and strategy use. Subgroups were compared on external measures related to problem-solving, IQ, creativity, attribution, and academic achievement. No quantitative differences in external measures were found between subgroups, except that the gifted prototype differed on measures of attribution and mathematical achievement. (PsycLIT Database 1992)

Swanson, H. L., J. E. O'Connor, et al. (1990). "An information processing analysis of expert and novice teachers' problem solving." American Educational Research Journal **27**(3): 533-556.

Examined qualitative differences between expert and novice teachers in their think aloud protocols related to solving classroom discipline problems. Expert and novice teachers were presented vignettes, under 2 instructional conditions--directive and nondirective--and were asked to "think aloud" as they were solving problems. Data from the think aloud protocols indicated that, in the absence of directive instructions, expert teachers formed more elaborate heuristic and strategy statements, whereas under directive instructions their statements about mental processes were similar to novices. In terms of solutions, expert teachers were more likely to rely on environment interventions when compared to novice teachers. Although instructional conditions influenced expert teachers' solutions, these effects were isolated to certain problems. Results suggest that expert and novice teachers differ in terms of their solutions and statements about mental process related to classroom discipline problems. (PsycLIT Database 1997)

Tessmer, M. (1994). "Formative evaluation alternatives." Performance Improvement Quarterly **7**(1): 3-18.

Describes alternative methods, resulting from changes in design practice, technology, and learning theory, that are being used to complement or replace the traditional formative evaluation paradigm. A definition is provided and the advantages, disadvantages, and

applicable contexts for 8 formative evaluation methods are outlined: 2-on-1 or dyadic evaluation, think-aloud protocol, computer interviewing, self-evaluation, panel review, evaluation meetings, computer journals, and rapid prototyping. (PsycLIT Database 1994)

Thomas, A. (1989). "Problem solving among pairs of achieving and learning disabled students." Alberta Journal of Educational Research **35**(1): 80-95.

56 pairs of students (aged 10-11.6 yrs) classified as gifted, learning disabled (LD), or average achievers engaged in a river-crossing problem-solving task using think-aloud procedures. LD students were further classified as either helpless or mastery-oriented. Transcriptions of videotaped sessions were analyzed for use of heuristics and affective variables and for sequences of moves toward solution. While LD pairs differed from gifted and average pairs in solution, frequency of recognition errors, bizarre moves, and aspects of strategy use, no differences were found between gifted and average groups. For the LD groups, deficits were identified in cognitive processes of comparison and evaluation, while metacognitive strategies for rereading or drawings indicated no differences compared with achieving students. (PsycLIT Database 1989)

Towns, M. H. and W. R. Robinson (1993). "Student use of test-wiseness strategies in solving multiple-choice chemistry examinations." Journal of Research in Science Teaching **30**(7): 709-722.

Investigated the test-wiseness strategies (TWSs) of 11 general chemistry students who answered a 15-item multiple-choice examination, using a think-aloud technique. Transcripts were coded, and the frequency of each strategy was tabulated. The most common TWSs were those that did not compromise the validity of the examination: error avoidance, elimination of incorrect responses, checking responses, and optimal time management. A less common set of TWSs helped students gain points beyond those for specific content knowledge. These include deductive reasoning strategies such as similar options, opposing options, absurd options, and an umbrella term. Results indicate that TWSs are independent of subject area and support the idea of written justifications for responses to multiple-choice items. (PsycLIT Database 1994)

Trabasso, T. and J. P. Magliano (1996). "Conscious understanding during comprehension." Discourse Processes **21**(3): 255-287.

Investigated conscious understanding during narrative comprehension as revealed through the use of think-aloud methodology and presented analytical model of conscious understanding as revealed through verbal protocol, which assumes that inference and memory processes function together in order to construct a coherent, mental representation of text. Verbal protocol were obtained by 8 college students reading 4 hierarchical and 4 sequential versions of 8 stories generating a total of 2,838 clauses. Think-aloud data indicates conscious understanding is explanation based. Coherent understanding is achieved by keeping available via maintenance or retrieval higher order goal information that explains a number of actions and outcomes of a plan. It is asserted that think-aloud data directly reflects information that is consciously available to the reader during comprehension. (PsycLIT Database 1997)

Underwood, M. K. and R. L. Wald (1995). "Conference-style learning: A method for fostering critical thinking with heart. Meeting of the Society for Research in Child Development (1993, New Orleans, Louisiana)." Teaching of Psychology **22**(1): 17-21.

Conference teaching, developed at Reed College, fosters critical thinking, defined as the ability to evaluate inferential networks and research designs, the confidence to listen to one's own intuitions about what matters, and the sensitivity to recognize and evaluate the goals of others from diverse backgrounds. Teachers contribute to conference-style learning by explaining expectations for classroom behavior, carefully choosing primary source readings, and molding class discussions by posing and responding to questions in strategic ways. To benefit from conference-style learning, students must read assigned materials carefully, practice formulating analytic questions, think aloud about challenging

issues, and learn to respect their own intuitions and those of others. The benefits of conference-style learning far outweigh its potential risks, as students learn to practice critical but considerate thinking. (PsycLIT Database 1995)

Veenman, M. V. and J. J. Elshout (1990). "De meerwaarde van een goede probleemaanpak. (The greater value of a good problem-solving approach.)." Tijdschrift voor Onderwijsresearch **15**(6): 337-346.

Studied the relation among intellectual ability, novice problem-solving behavior, and learning in 2 different learning environments. Human subjects: 19 normal Dutch adults (undergraduate students). Ss were administered a battery of 6 intelligence tests. High-intelligent and low-intelligent novices in the field of physics were assigned to a structured or an unstructured learning condition involving mastery of the main principles of electricity theory. The quality of problem-solving behavior was assessed by analyzing tape-recorded think-aloud protocols. Analyses of variance (ANOVAs) and a correlational analysis were performed. (English abstract) (PsycLIT Database 1991)

Vehrs, W. (1980). "Structuralization and aesthetical appreciation." Psychologische Beitrage **22**(2): 250-258.

Examined 2 approaches to the conditions of aesthetic appreciation: an analysis of aesthetic objects and an analysis of Ss' structuralization of aesthetic objects. Ss were asked to think aloud during and after a viewing of colored patterns to indicate their amount of pleasure. Responses were analyzed with regard to width and height of structuralization. The amounts of these 2 variables were correlated with judgments of aesthetic appreciation. (French abstract) (10 ref) (PsycLIT Database 1981)

Venezky, R. L. and W. S. Bregar (1988). "Different levels of ability in solving mathematical word problems." Journal of Mathematical Behavior **7**(2): 111-134.

18 5th-8th grade students and 10 female college students were assessed for basic knowledge of percentage. The better students in each group (6 middle school Ss and 5 college Ss) were then given word problems involving percentage and asked to "think aloud" as they tried to solve each problem. College Ss solved more problems successfully than middle school Ss but differed from the latter in the more frequent use of strategies for control and monitoring of their own problem-solving procedures. A 3-stage model for problem solving is hypothesized, involving text translation, solution identification, and solution generation. In this model, problem solving proceeds from stage to stage but overlap and backtracking can occur. Errors are accounted for by faulty rules, which can occur in any stage. (PsycLIT Database 1989)

Vining, J. and L. Fishwick (1991). "An exploratory study of outdoor recreation site choices." Journal of Leisure Research **23**(2): 114-132.

Used a think-aloud method to explore the process by which 10 graduate students made outdoor recreation site choices. During the choice process Ss verbalized their thoughts and feelings into a tape recorder. The choice processes were characteristic of compensatory and noncompensatory decision models. The compensatory choices were characterized by the addition of positively and negatively evaluated elements, the chosen site having more positively assessed features. The noncompensatory process was characterized by the presence of criterion variables, the presence or absence of which determined the choices. Findings also illustrated the importance of personal values and experiences, as well as site features and activities, in the site choice process. (PsycLIT Database 1991)

Vinze, A. S., A. Sen, et al. (1993). "Operationalizing the opportunistic behavior in model formulation." International Journal of Man Machine Studies **38**(3): 509-540.

Used the think-aloud approach to study the process of model formulation as undertaken by 9 Ss, 3 expert modelers each in the domains of production planning, forecasting, and auditing. An evaluation of the verbalizations by the Ss revealed the

predominant use of opportunism in the process. Opportunism is one approach to problem solving in which the modeler follows the most promising leads at any point in time. A cognitive model was used to categorize and understand the expert protocols as derived from the verbalizations. A comparison of the verbalizations using this model shows similarity in the process of formulation. The cognitive model was operationalized using a blackboard architecture. (PsycLIT Database 1993)

Vis Dube, R. (1995). "Protocol analysis: Applications in rehabilitation." Canadian Journal of Rehabilitation **9**(1): 27-32.

Protocol analysis is a procedure that provides access to information regarding an individual's cognitive processes during problem-solving. This is accomplished by having the person "think aloud" while performing a task, and systematically analyzing the output. This procedure, while popular in the fields of education and psychology, has seldom been used in rehabilitation. The purpose of this paper is to present protocol analysis as an option for clinical practice and research in rehabilitation. The procedure is described and discussed with regard to issues of reliability and validity. Applications in the field of rehabilitation are also presented. (French abstract) (PsycLIT Database 1997)

Ward, L. and D. Traweek (1993). "Application of a metacognitive strategy to assessment, intervention, and consultation: A think-aloud technique." Journal of School Psychology **31**(4): 469-485.

Reviews research on metacognition and suggestions are made for application of this knowledge by school psychologists in assessment, intervention, and consultation. Two empirical studies illustrate the application of a specific metacognitive strategy (the think-aloud procedure) to assessment and intervention. The 1st study, with 35 5th graders, showed that asking students to give reasons for responses improved performance on a test of reading comprehension. The 2nd study showed that incorporating the think-aloud technique in remedial reading instruction resulted in substantial gains in reading comprehension. (PsycLIT Database 1994)

Watson, K. L. and M. J. Lawson (1995). "Improving access to knowledge: The effect of strategy training for question answering in high school geography." British Journal of Educational Psychology **65**(1): 97-111.

55 high school seniors were trained to use a strategy to improve the application of knowledge in answering geography short-answer test questions. The strategy focused on strategic behaviors ranging from procedures for activating knowledge to use of executive strategies. This training was found to be effective in improving test performance. Analysis of think-aloud protocols of cognitive behavior while answering test questions showed that training was effective in encouraging the target strategic behaviors. (PsycLIT Database 1995)

Weaver, F. M. and J. S. Carroll (1985). "Crime perceptions in a natural setting by expert and novice shoplifters." Social Psychology Quarterly **48**(4): 349-359.

Deterrence theories rest on assumptions of how criminals think about crime opportunities. The present study examined the thought processes of 17 expert shoplifters and 17 novices during consideration of actual crime opportunities. Ss (aged 18-62 yrs) individually walked through retail stores with instructions to think aloud. Half of each group was additionally instructed to form an intention to shoplift during their "shopping trip." The verbal protocols were tape-recorded, transcribed, and coded. Expert shoplifters were more efficient and strategic than nonshoplifters in their shoplifting considerations. Deterrents to shoplifting for novices included fear, guilt, and the possibility of being caught. Experts were deterred by strategic difficulties, such as size of the item. Experts treated deterrents such as store personnel and security devices as obstacles they could overcome, whereas novices decided against shoplifting in the presence of any deterrent. Environmental influences on shoplifting thoughts and the evaluation of potential crime opportunities are discussed. (46 ref) (PsycLIT Database 1987)

Wedell, D. H. and S. M. Senter (1997). "Looking and weighting in judgment and choice." Organizational Behavior and Human Decision Processes **70**(1): 41-64.

Clarified the relationship between behavioral looking measures with the theoretical construct of weight. A sampling model was proposed in which the weight given to a piece of information corresponds to the amount of sampling of that information in either a continuous, discrete or strategic manner, which were related to process tracing measures of initial and additional time per and frequency of acquisition. Ss were 215 college students who uncovered information corresponding to verbal and math aptitude scores of hypothetical applicants. Ss judged the likelihood of success in a designated major or chose 1 from pair of applicants who they believed to be more likely to succeed. Judgment data demonstrated large effects of task focus on the weighting of verbal and math scores and corresponding increases in number of acquisitions and time per acquisition on the information receiving more weight. Analyses of choice proportions revealed effects of task focus on weight and bias parameters. Initial looks reflected orientation and screening functions and additional looks reflected more evaluative processes. Similarities and differences among groups of Ss who were classified as following different identifiable choice strategies were also explored. (PsycLIT Database 1997)

Wedman, J., J. Wedman, et al. (1996). "Analysis of analogical problem-solving processes via think-aloud protocols." Journal of Research and Development in Education **30**(1): 51-62.

Identified the underlying cognitive processes employed by problem solvers. Think-aloud protocols from 40 undergraduate elementary education majors asked to solve analogous problems were coded using A. H. Schoenfeld's (1985) problem solving framework. Data analysis showed that successful problem solvers differed from unsuccessful problem solvers in 3 ways. First, perhaps due to their tendency to notice the analogous relationships between the source and target problem, successful Ss were more efficient. Second, successful problem solvers evidenced a predictable approach as they solved the problems. Third, several of the successful problem solvers drew appropriate analogies between their life experiences and the target problem. Since these problem solvers referred to life experiences (not the source problem) for the analogy they used to solve the target problem, the degree to which the source problem was meaningful and important to them was limited. (PsycLIT Database 1997)

Wegner, D. M. and D. B. Gold (1995). "Fanning old flames: Emotional and cognitive effects of suppressing thoughts of a past relationship." Journal of Personality and Social Psychology **68**(5): 782-792.

Cognitive and electrodermal effects of suppressing thoughts of an old flame were examined in 2 experiments. Participants were asked to think aloud about an old flame--a past close relationship that either was or was not still desired--as their skin conductance level (SCL) was measured. Participants continued to think aloud as they were instructed either not to think about their old flame or to perform a comparison task. Participants were then asked to think about the old flame again. Participants who had suppressed thoughts of a no-longer-desired relationship were inclined to think aloud more about it afterward whereas those who suppressed thoughts of a still-desired relationship did not show such a rebound but evidenced increased SCL. (PsycLIT Database 1995)

Wegner, D. M., J. W. Shortt, et al. (1990). "The suppression of exciting thoughts." Journal of Personality and Social Psychology **58**(3): 409-418.

We examined how the suppression of an exciting thought influences sympathetic arousal as indexed by skin conductance level (SCL). Subjects were asked to think aloud as they followed instructions to think about or not to think about various topics. Experiment 1 showed that trying not to think about sex, like thinking about sex, elevates SCL in comparison to thinking about or not thinking about less exciting topics (e.g., dancing). Experiment 2 revealed that the suppression of the thought of sex yielded SCL elevation

whether or not subjects believed their think-aloud reports would be private or public, and it also revealed that the effect dissipated over the course of a few minutes. Experiment 3 found such dissipation again but showed that subsequent intrusions of the suppressed exciting thought are associated with further elevations in SCL over 30 min. Because such an association was not found when subjects were trying to think about the exciting thought, it was suggested that the suppression of exciting thoughts might be involved in the production of chronic emotional responses such as phobias and obsessive preoccupations. (PsycLIT Database 1990)

Westenberg, M. R. and P. Koele (1992). "Response modes, decision processes and decision outcomes. 13th Research Conference: Subjective probability, utility and decision making (1991, Fribourg, Switzerland)." Acta Psychologica **80**(1-3): 169-184.

Examined the effects of response modes in relation to 2 explanations proposed in recent response mode studies: the compatibility hypothesis and the response mode continuum. An experiment was conducted with a process tracing technique (information boards), in which 104 psychology students made decisions on the quality of student papers submitted for publication. Four response modes were compared: selecting, rejecting, classifying, and ranking of alternatives. In addition, information load was manipulated. Response mode influenced both the decision process and the decision outcome. Results are interpreted as supporting the response mode continuum idea, but not the compatibility hypothesis. A classification of response modes is proposed. (PsycLIT Database 1993)

Westenberg, M. R. M. and P. Koele (1994). "Multi-attribute evaluation processes: Methodological and conceptual issues. Special Issue: Multi-attribute evaluation processes: Judgement and choice." Acta Psychologica **87**(2-3): 65-84.

Discusses methodological and conceptual issues related to psychological judgment and decision-making research. Two types of multi-attribute evaluation are discussed (i.e., judgment and choice). The development and characteristics of the research paradigms used for studying multi-attribute judgment and choice, structural modeling, and process tracing, are also discussed. A central issue in both paradigms is the question of whether the multi-attribute evaluation process follows compensatory or noncompensatory principles. This issue is related to various aspects of the research paradigms (linearity, additivity, and configurality of the models used in the structural modeling approach, and information load and response mode in the process-tracing approach). In general, judgment follows compensatory and choice follows noncompensatory principles. (PsycLIT Database 1995)

Whitney, P. and D. Budd (1996). "Think-aloud protocols and the study of comprehension." Discourse Processes **21**(3): 341-351.

Discusses assumptions behind think-aloud method (TAM), the specific aspects of comprehension that it can reveal, and new directions for research that use TAM. It is argued that TAM is a useful technique for tracking changes in the contents of working memory during comprehension, but needs new approaches to protocol analysis and more research on the relation between the verbal protocols and other assessments of discourse representations. (PsycLIT Database 1997)

Whitten, W. B. and J. M. Leonard (1981). "Directed search through autobiographical memory." Memory and Cognition **9**(6): 566-579.

Two experiments studied retrieval from a well-ordered set of overlearned information in long-term autobiographical memory. In Exp I, each of 161 undergraduates were asked to recall the name of 1 teacher from each of the 12 pre-university school years. Recall was cued in forward (Grades 1-12), backward (Grades 12-1), or random order. Backward-ordered search proved most efficient: Fewer Ss failed to complete the task in that search order, and those who did complete the task were faster than the successful Ss in the other search orders. In Exp II, 148 Ss were asked to "think aloud" as they attempted recall.

From the resulting protocols, 25 categories of verbal reports were identified, including 4 that reflected retrieval strategies. Omission errors (failures to recall teachers' names) and, with 1 exception, frequencies of verbal reports decreased as recency increased. Overall results show that the recall of 1 item can indirectly aid the recall of contiguous items and that the probability of recalling an item from autobiographical memory is primarily a function of recency. (34 ref) (PsycLIT Database 1982)

Willson, V. L. (1987). "Methodological limitations of the application of expert systems methodology in reading." Reading Psychology **8**(2): 73-81.

Discusses the use of expert-novice methodology in reading research. Four techniques are prominent in this methodology: intact group comparisons, think-aloud protocols, retrospective analysis, and naturalistic inquiry. Internal validity threats are identified for each technique, and examples presented from the research. It is argued that the use of good and poor readers in any research using the discussed techniques to assess curriculum change must be carefully evaluated. Longitudinal and descriptive studies on poor readers are recommended instead for such research. (PsycLIT Database 1988)

Willson, V. L. (1990). "Methodological limitations for the use of expert systems techniques in science education research." Journal of Research in Science Teaching **27**(1): 69-77.

Examined the use of the expert-novice technique in science education. Four techniques that have been associated with expert-novice investigations are discussed with respect to their methodological limitations: intact groups comparisons, think-aloud procedure, retrospective studies, and naturalistic inquiries. All 4 have serious limitations in their capability to inform instructional research. V. L. Willson argues that experimental design is still the most appropriate method of use in assigning cause in instructional research involving novices and change in novices. The concept of competence should be substituted for expertise. Appropriate populations under this construct are students who have moved from novice to competence. (PsycLIT Database 1990)

Wong, B. Y. (1988). ""Diagnosis diagnosed: Twenty years after": Comment." Professional School Psychology **3**(2): 141-143.

Commends the timeliness and significance of the process-oriented approach in assessment for school psychologists proposed by J. Meyers (see PA, Vol 76:10292) but raises the issue of constraints of using the think-aloud procedure. (PsycLIT Database 1989)

Wright, P. C. and A. F. Monk (1991). "A cost-effective evaluation method for use by designers." International Journal of Man Machine Studies **35**(6): 891-912.

Conducted 2 studies in which trainee designers evaluated a user interface by observing users in a cooperative evaluation procedure as they worked through some set tasks. Study 1 examined the effectiveness of 27 trainee designers as evaluators of an existing bibliographic database. Study 2 examined whether being the designer of a system made one better or worse at evaluating it and whether 32 designers could predict the problems users would experience in advance of user testing. Study 1 showed that getting users to think aloud while observing their performance led to satisfactory detection rates, which were achieved in a short space of time, by people with little human factors background, and with a long training overhead. In Study 2, designers evaluating their own systems detected more usability problems than similarly experienced evaluators who had been involved in the design. (PsycLIT Database 1992)

Wulfert, E., M. J. Dougher, et al. (1991). "Protocol analysis of the correspondence of verbal behavior and equivalence class formation." Journal of the Experimental Analysis of Behavior **56**(3): 489-504.

In 2 equivalence experiments, a "think aloud" procedure examined 24 undergraduates' covert verbal responses during matching to sample to identify variables

that might explain individual differences in equivalence class formation. Results from Exp 1 suggest that Ss who formed equivalence classes described the relations among stimuli, whereas those not showing equivalence described sample and comparison stimuli as unitary compounds. Because Exp 1 only demonstrated a correlation between describing stimulus compounds and absence of equivalence classes, Exp 2 was conducted. In it, equivalence class formation was brought under experimental control through pretraining that facilitated responding to stimulus compounds or to relations among stimuli. A history of describing stimulus compounds, compared with describing relations among stimuli, interfered with emergence of stimulus equivalence. (PsycLIT Database 1992)

Zeitz, C. M. and K. T. Spoehr (1989). "Knowledge organization and the acquisition of procedural expertise." Applied Cognitive Psychology **3**(4): 313-336.

Investigated the influence of the organization of a declarative knowledge base on the development and application of proceduralized knowledge in a complex troubleshooting (TS) domain. Four undergraduates' transition was traced from novices to experts on the MAZER system. Domain explanations were generated in a depth-first (DF) or breadth-first (BF) manner. Although DF and BF explanations led to similar training performance, Ss receiving BF explanations showed superior performance in subsequent TS problems. Objective measures of TS performance and think-aloud protocols indicate that BF representation fostered the use of mental models during problem-solving in training and facilitated development of procedures to turn knowledge into fast and accurate methods for localizing faults. (PsycLIT Database 1991)

Zietsman, A. and J. Clement (1997). "The role of extreme case reasoning in instruction for conceptual change." Journal of the Learning Sciences **6**(1): 61-89.

Uses qualitative analyses of tutoring transcripts as an empirical base to develop hypotheses about the role of extreme cases in learning and teaching. Observation data (from think-aloud tutoring sessions in a 7th grade teaching unit about levers) support the view that extreme cases provide a firm data point or comparison that helps students to establish an ordinal relation between 2 given variables. Two new additional roles for extreme cases in fostering learning are also identified: (1) activation of an intuition, often in the form of a perceptual motor schema, that is used in constructing an imageable, intuitively grounded, explanatory model as opposed to an empirical rule; and (2) facilitation of the formation of new causal variables. These roles are candidates for inclusion in a set of general learning strategies for science instruction. The authors highlight the importance for instructional design of research that uncovers students' existing knowledge structures and natural reasoning processes, and suggest that explanatory model construction, causal relation construction, and concept formation can result from such instructional designs. The extent to which these 3 outcomes are evidence for strong conceptual change is also discussed. (PsycLIT Database 1997)

Zins, J. E. and C. R. Ponti (1985). "Strategies for enhancing child and adolescent mental health." Special Services in the Schools **1**(3): 49-60.

Discusses 3 approaches to mental health promotion in schools for children and adolescents: (1) preventing the onset of disorders, (2) strengthening competencies to enable children and adolescents to better handle life stressors, and (3) assisting children and adolescents in dealing with life transitions. Examples of strategies for the 1st approach include group screening, client-centered consultation, inservice training, parent education programs, curricular modification, and the Primary Mental Health Project developed by E. L. Cowen et al (1975). Techniques for the 2nd approach include an interpersonal cognitive problem solving program developed by M. B. Shure and G. Spivak (1974) and Spivak et al (1976), M. A. Camp and B. W. Bush's (1981) Think Aloud Program, and a structured learning therapy program developed by A. P. Goldstein et al (1980). Examples of the 3rd approach include antecedent systematic desensitization and training in self-management. (18 ref) (PsycLIT Database 1986)

Zualkernan, I. A. and P. E. Johnson (1992). "Metaphors of reasoning as problem-solving tools. Special Issue: Expertise and metaphor." Metaphor and Symbolic Activity **7**(3-4): 157-184.

Examines 2 models of scientific reasoning (dogmatic and sophisticated falsification) as metaphors for the problem-solving activities of a specific work role. Think-aloud protocol data were used to identify problem-solving methods of 2 electronics experts performing process diagnosis in a very large scale integration fabrication environment. The expert with more experience used sophisticated falsification whereas the expert with less experience used both dogmatic falsification and sophisticated falsification. Computational models were constructed and compared with performance of the experts on a sample of diagnostic problems. A neural network was also constructed to examine the development of the 2 reasoning models. The developmental study suggests that sophisticated falsification may be a natural metaphor for diagnosis under the assumption of expectation-based learning and environments of complexity and change. (PsycLIT Database 1993)

Zwaan, R. A. and C. M. Brown (1996). "The influence of language proficiency and comprehension skill on situation-model construction." Discourse Processes **21**(3): 289-327.

Investigated the effects of language proficiency and comprehension skill on situation-model construction during narrative comprehension in 2 studies involving 12 native English speaking college students, categorized as either high or low language comprehenders and enrolled in a 2nd yr French class. In Study 1, Ss were asked to think aloud during a comprehension of 2 English and 2 French fables. In Study 2, Ss completed a verb-clustering task based upon their memory of the story. Results show high skilled Ss generated more explanatory inferences and stronger situation models then less skilled comprehenders; therefore, skilled comprehenders have more highly integrated situation models in long term memory than less skilled comprehenders. These situation models not only incorporate causal and motivational connections between the events, but also temporal, spatial, and protagonist-related connections. (PsycLIT Database 1997)